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SELECTED WATER RESOURCES ABSTRACTS

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SEPTEMBER 1988

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 21, NUMBER 9
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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1988 .

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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01 NATURE OF WATER

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

INDICES OF HYDROLOGICAL DROUGHT IN ISRAEL,
Israel Hydrological Service, P.O. Box 6381, Jerusalem, Israel.
A. Ben-Zvi.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 179-191, June 30, 1987. 1 fig, 5 tab, 2 ref.

Descriptors: *Streamflow, *Rivers, *Drought, *Data collections, *Water shortage, Israel, Hydrologic data collections, Semiarid lands, Ephemeral streams, Perennial streams.

Examination of annual streamflow volumes for 14 rivers in Israel (4 perennial, 4 seasonally flowing, 6 ephemeral) showed that no drought occurred within the time of the available hydrological records (about 30 years). The indices of drought were depth, duration, and extent. Drought was defined as a severe shortage in the appearance of natural waters with respect to normal for place and time. Severe shortage was defined as a deep, continuous and widely extended shortage. However, within the time span of the records, two events of an extended deep shortage (1950/1951 and 1978/1979) and two events of an extended continuous shortage (late-fifties and mid-seventies) occurred. A deep shortage was defined as a case when the annual volume of the streamflow is lower than the mean by at least one standard deviation. A continuous shortage was defined as a case when the annual volume of streamflow is lower than the mean for at least four successive years. (Cassar-PTT)
W88-07114

STATISTICAL APPROACH OF THE ARIDIFICATION PROCESS IN WESTERN AFRICA (APPROCHE STATISTIQUE DE L'ARIDIFICATION DE L'AFRIQUE D L'OUEST),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France).
For primary bibliographic entry see Field 2B.
W88-07200

RECURSIVE ESTIMATION OF KERNELS OF NONLINEAR RAINFALL-RUNOFF MODELS,
Dames and Moore, 4950 West Kennedy Boulevard, Suite 410, Tampa, FL 33609.
S. G. Rao, and A. R. Rao.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 341-364, 30 November 1987. 6 fig, 7 tab, 19 ref. USDI Title II Project C-3277.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Estimating equations, *Nonlinear programming, *Algorithms, *Data processing, Linear programming, Hydrologic data, Runoff forecasting, Computer models, Kentucky, Computers.

Two algorithms, one for estimating the kernels of nonlinear functional series models of the rainfall-runoff process using a fixed length of rainfall-runoff data, and the other for updating the kernel estimates as additional data becomes available are proposed. These recursive algorithms are based on the steepest gradient method to minimize the mean square error between the observed and model runoff and are useful for on-line prediction of runoff. The kernels are estimated directly without any polynomial approximation of kernels or transformation of inputs. The estimation schemes are applied to model the daily rainfall-runoff process in the Rough River basin in Kentucky and the prediction results of both the linear and nonlinear models are compared. The prediction performance of the nonlinear model is shown to be superior to that of the linear model. Validation of these models and fitting additional models to residuals are emphasized so that the prediction performance of the nonlinear functional series may be improved. It may be noted that the algorithms can also be used for multiple inputs and multiple outputs with considerable savings in computer storage and computations. (Author's abstract)
W88-07210

RELATIONSHIP BETWEEN ANNUAL RUNOFF AND WATERSHED AREA FOR THE EASTERN UNITED STATES,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2E.
W88-07275

COMPARISON OF THE LARGEST RAINFALL-RUNOFF FLOODS IN THE UNITED STATES WITH THOSE OF THE PEOPLE'S REPUBLIC OF CHINA AND THE WORLD,
Cascades Volcano Observatory, U.S. Geological Survey, Vancouver, WA 98661.
For primary bibliographic entry see Field 2E.
W88-07392

DETERMINISTIC APPROACH TO INFLOW DESIGN RAINFLOOD DEVELOPMENT AS APPLIED BY THE U.S. BUREAU OF RECLAMATION,
Flood Section, U.S. Bureau of Reclamation, PO Box 25007, Denver, CO 80225.
A. G. Cudworth.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 293-304, December 1987. 6 fig, 1 tab, 13 ref.

Descriptors: *Probable maximum precipitation, *Drainage patterns, *Maximum probable floods, *Design storms, *Design floods, *Hydraulic efficiency, *Flood basins, *Flood hydrographs, *Flood data, Unit hydrographs, Infiltration, Ungaged basins, Estimating, Bureau of Reclamation, History.

The historical development of the deterministic approach used in the analysis of extraordinary flood events, namely the probable maximum flood, by the Bureau of Reclamation, is discussed. Also presented is an historical perspective of infiltration and unit hydrograph theories employed by the Bureau in generating flood hydrographs. The current hydraulically based adaptation of the traditional unit hydrograph approach for modelling the conversion of rainfall to runoff is presented, based on over a hundred flood hydrograph reconstitution studies and the identification of interrelationships between unit hydrograph features and certain well-defined basin hydraulic properties. Among the properties identified and discussed are the geometric configuration of the drainage network as developed by geological processes and the hydraulic characteristics of the drainage network in terms of the system's hydraulic efficiency in conveying extreme magnitude flood discharges to points of runoff concentration. The generation of hydrographs for ungaged basins using the approach is discussed with emphasis placed on the quantification of hydraulic parameters during field reconnaissances by hydrologists. Additionally, the modification of observed unit hydrographs to reflect basin hydraulic conditions associated with extreme events is discussed. The approach used for assigning infiltration rates suitable for extreme flood hydrograph development is covered, together with assumptions and techniques for combining the several physical meteorological and hydrologic components to form the design flood hydrographs. (Author's abstract)
W88-07406

INFLUENCE OF VARIATION IN FOREST COVER ON DESIGN FLOODS,
Northeast Hydroelectric Investigation and Design Institute, MWREP, Changchun, Jilin Province (P.R. of China).
For primary bibliographic entry see Field 2E.
W88-07412

EFFECT OF STORM SCALE ON SURFACE RUNOFF VOLUME,
Princeton Univ., NJ. Water Resources Program.
P. C. D. Milly, and P. S. Eagleson.
Water Resources Research WRERAO, Vol. 24, No. 4, p 620-624, April 1988. 4 fig, 18 ref. NSF Grants ATM-7812327, ATM-8114723 and CEE-8307282.

Descriptors: *Rainfall-runoff relationships, *Rainfall intensity, *Model studies, *Infiltration, Hydrology, Spatial distribution, Regional analysis, Storms, Runoff, Rainfall.

Dynamic hydrologic models of areas that are potentially larger than characteristic storm sizes must give explicit consideration to the effect of storm size on the rainfall-runoff process. The local response of an element of the modeled area can be assigned parameters in terms of proportion of saturated and impermeable area and infiltration parameters of the unsaturated permeable areas. When a very simple spatial description of the storm depth and duration is provided, it is possible to integrate the local response over the entire area to obtain the average, or lumped, input-output behavior of the large area on a volume basis. Where infiltration-excess runoff is significant, the rainfall-runoff response of a large area is extremely sensitive to the storm size, with a fixed volume of precipitation producing more runoff when it is concentrated over smaller areas. Where saturated or impermeable source areas provide most of the surface runoff, this scale effect on runoff volume is absent. Whenever the effect is significant, it becomes important for rainfall-runoff models to include not only the rainfall volume but also some description of its areal variability, as forcing variables. (Author's abstract)
W88-07453

WATER LOSSES FROM IRRIGATION CANALS,
Birmingham Univ. (England). Dept. of Civil Engineering.
E. Wachyan, and K. R. Ruston.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 275-288, July 15, 1987. 5 fig, 5 tab, 8 ref.

Descriptors: *Irrigation canals, *Mathematical models, *Surface-groundwater relations, *Canal linings, *Canal seepage, *Canal construction, Water table, Canals, Model studies, Linings, Aquifers, Irrigation.

The water losses from a canal to an aquifer were investigated. From field measurements, large losses from canals have been identified, even when the canal is lined. The reasons for these losses were investigated by performing numerical model solutions for a series of examples with different conditions at the lower boundary of the aquifer, at lateral boundaries, and at the water table within the aquifer. Partial lining of the canal is shown to have little effect on the magnitude of the losses and total lining which contains defects is also ineffective. The need for detailed field work into the conditions within aquifers in the vicinity of canals is emphasized. (Author's abstract)
W88-07515

BUSHFIRE HYDROLOGY - THE CASE OF LEAKING WATERSHEDS,
A.C.T Water Authority, G.P.O. Box 863, Canberra City, A.C.T. 2601 (Australia).
T. M. Daniell, and V. Kulik.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 301-313, July 15, 1987. 5 fig, 11 ref.

Descriptors: *Rainfall-runoff, *Forest hydrology, *Mathematical models, *Forest fires, *Water yield, Model studies, Bushfires.

A new mechanism for water yield change after bushfires is proposed. A simplified model for the calculation of the shift in yield due to bushfires has been developed. The model describes both the short-term increase of water yield immediately after bushfire and the long-term decrease during the following years. (Author's abstract)
W88-07517

KINEMATIC OVERLAND FLOW - GENERALIZATION OF ROSE'S APPROXIMATE SOLUTION, PART II,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2E.
W88-07520

ESTIMATION OF VOLUME OF SNOWMELT FROM TEMPERATURE OF SNOW LINE AND RESIDUAL SNOW AMOUNT,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
M. Hino, M. Hasebe, and K. Noda.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 25-39, August 15, 1987. 11 fig, 3 tab, 11 ref.

Descriptors: *Snowmelt, *Runoff, *Mathematical models, *Air temperature, Hydrology, Hydrologic data, Okutadami Basin, Japan, Model studies, Temperature, Runoff volume.

The relation between snowmelt and cumulative air temperature or cumulative areal air temperature was analyzed in accordance with the degree-day method applied to hydrological data for the Okutadami basin. On occasion, the volumes of snowmelt obtained by the conventional degree-day method were unsatisfactory. A new snowmelt runoff model is proposed involving not only the volume of snowmelt and cumulative air temperature but also residual snow amount. The formula presumes that snowmelt takes place around the snow line and that the volume of snowmelt is proportional to the product of cumulative air temperature at the snowline and the residual snow amount, if the relation between altitude and logarithmic snow-covered area is linear. The formula is applicable to an area where the effect of direct sunshine is negligible, i.e., either the weather is cloudy or the mountain slopes northward (in the northern hemisphere). (Roseman-PTT)
W88-07523

SIMPLE MATHEMATICAL MODEL OF A COMPLEX HYDROLOGIC SYSTEM - OKAVANGO SWAMP, BOTSWANA,
T. Dincer, S. Child, and B. Khupe.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 41-65, August 15, 1987. 14 fig, 4 tab, 17 ref.

Descriptors: *Mathematical models, *Hydrologic budget, *Hydrologic cycle, *Water level, *Swamps, Wetlands, Model studies, Okavango Swamp, Botswana, Flow discharge.

A simple mathematical model of the Okavango Swamp in northern Botswana has been developed to simulate the hydrologic conditions in the swamp. The model consists of a number of cells along the flow line for each distributary system. Each cell is represented by a reservoir having a triangular cross section. Outflow from cells is proportional to the volume of the cells, corrected for dead storage when necessary. Water balance of each cell is calculated starting from the cell upstream and the outflow is distributed when there are more than one cell downstream. The model was calibrated using measured discharges and water levels in the swamp and using satellite imagery. The mathematical model clearly shows changes in the flow distribution in the Okavango Swamp, and can predict the effect of man made changes in the inflow and in the swamp. In order to increase the validity of the model, more physical and hydraulic variables need to be introduced in the model's mathematical structure and information on the groundwater should be included in greater detail in the water balance. (Roseman-PTT)
W88-07524

PHYSICALLY-BASED MODEL FOR THE AGROHYDROLOGIC PROCESSES,
R. Al-Soufi.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 199-219, September 15, 1987. 10 fig, 2 tab, 11 ref.

Descriptors: *Soil water, *Soil-water-plant relationships, *Model studies, *Mathematical models, *Agricultural watersheds, Watersheds, *Evapotranspiration, *Subsurface flow, Storm seepage, Flow, Evaporation, Transpiration, Soil physical properties, Meteorological factors, Model studies, Agriculture, Water management, Sweden.

A physically-based mathematical model has been developed to simulate the four most important parts of the watershed continuum that are controlled by the properties of soils and plants and by meteorological factors. The model couples three-dimensional transient subsurface flow (varied saturation soil water flow), soil evaporation and plant transpiration, forest interception and one-dimensional unsteady overland flow. The nonsteady, saturated and unsaturated subsurface flow module uses a finite difference method to solve numerically the soil water flow equations. The evaporation-transpiration module which has dynamic properties, calculates the soil evaporation and plant transpiration separately. It takes into consideration, the influence of the vegetation, soil moisture status, vegetative cover intensity and depth of root zone. The overland flow module uses the single step Lax-Wendroff explicit technique to solve numerically the kinematic wave equation. The main aspects of the model and its potential capabilities have been studied and visualized for Nolsjon watershed in south Sweden during summer periods. The results indicate that this computational tool can provide valuable information for water development and management. (Author's abstract)
W88-07560

PRECIPITATION AND STREAMWATER CHEMISTRY IN A SUBARCTIC SCOTTISH CATCHMENT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W88-07561

HYDRAULICS AND BASIN MORPHOMETRY OF THE LARGEST FLASH FLOODS IN THE CONTERMINOUS UNITED STATES,
Cascades Volcano Observatory, Vancouver, WA.
For primary bibliographic entry see Field 2E.
W88-07566

MECHANISMS OF CATCHMENT FLOW PROCESSES USING NATURAL VARIATIONS IN DEUTERIUM AND OXYGEN-18,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
J. V. Turner, D. K. Macpherson, and R. A. Stokes.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 143-162, October 15, 1987. 9 fig, 1 tab, 24 ref.

Descriptors: *Rainfall-runoff relationships, *Deuterium, *Oxygen isotopes, *Isotope tracers, *Groundwater movement, *Groundwater recharge, *Streamflow, Seasonal variation, Flow, Streams, Rainfall-runoff relationships, Western Australia, Catchment areas, Tracers.

Stable isotope compositions and chloride concentrations in rainfall, deep and shallow groundwaters and streamflow have been used to investigate the flow processes through a small catchment in southwest Western Australia. In addition to the stable isotope and chloride data, daily rainfall, streamflow rate, streamflow chloride concentrations and shallow and deep groundwater hydrographs were used in an integrated approach to determine the mechanisms of streamflow generation. The range in delta O18 and delta H2 of rainfall events incident to the catchment during 1985 was 9.0 and 60 %, respectively, and was large enough to be useful in tracing flows generated from them through the catchment. During the season, four separate rainfall events were analyzed using stream hydrograph separation methods based on delta O18, delta H2 and chloride. Results showed that between 60 and 95% of the streamflow generated from the respective events had originated from pre-event shallow groundwater within the catchment. The seasonal pattern in the streamflow isotopic composition during 1985 was also analyzed. Most significant rainfall events during the season generated an almost immediate response in the streamflow isotopic composition. The response to individual rainfall events was strongest early in the season but diminished as the season progressed. This attenuation with time indicated isotopic mixing and dilution of individual rainfall events with the increasing storage of shallow groundwater as the season progressed. Kalman filtering methods were used to investigate the function linking rainfall volume and streamflow and also the average time lag between rain and flow, using delta values in rainfall as time markers. The analysis showed a range of ages for the streamflow from about 20 to about 50 days lag after rainfall, tending to decrease after rainfall events and then increase again. The estimated value of the lag was always significantly greater than zero. Deep and shallow groundwaters in the 1985 season were readily distinguished from each other in delta O18-delta H2 space. Streamflow isotopic composition matched that of the shallow groundwater system for almost the entire season. (Author's abstract)
W88-07575

LONG RANGE STREAMFLOW AND WORLD CONTINENTAL RUNOFF FLUCTUATIONS SINCE THE BEGINNING OF THIS CENTURY,
Centre de Sedimentologie et de Geochimie de la Surface, Institut de Geologie, 1 rue Blessig, 67084 Strasbourg Cedex (France).
J.L. Probst, and Y. Tardy.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 289-311, October 30, 1987. 17 fig, 4 tab, 32 ref.

Descriptors: *Rainfall-runoff relationships, *Catchment areas, *Climatology, *Streamflow, *Runoff, *Data analysis, *Rivers, Climates.

Fifty major rivers, distributed all around the world, have been selected and since the beginning of this century their mean annual discharge fluctuations have been studied by filtering methods. The great hydroclimatic periods which have affected the different drainage basins were determined. The succession of dry and humid periods were compared at both regional and continental scales. Lags, oppositions, attenuations or correspondences between the hydroclimatic periods in the different drainage basins are distinguished. The runoff fluctuations of each continent were reconstituted using the discharge fluctuations of some selected and representative rivers. Thus, the world continental runoff fluctuations were calculated by summing the fluctuations of the different continent runoffs. The world continental runoff is greatly influenced by the Asiatic Continent. Furthermore, North American and European runoffs fluctuate in opposition while South American and African runoffs present synchronous fluctuations. The global runoff has been fluctuating but as an average has only increased about 3% during the last 65 years (1910-1975). The humid years seem to be centered around 1915, 1927, 1950, 1960 and 1972. On the contrary, the dry periods seem to be located around 1920, 1940, 1955 and 1965. (Author's abstract)
W88-07582

INFLUENCE OF THE TIDE ON RAINFALL IN A TIDAL AREA,
Institute of Earth Sciences, Amsterdam.
For primary bibliographic entry see Field 2B.
W88-07646

HYDROLOGIC ENGINEERING CENTER'S ACTIVITIES IN WATERSHED MODELING,
Hydrologic Engineering Center, Davis, CA.
G. W. Brunner.
Available from the National Technical Information Service, Springfield, VA. 22161, as ADA-184 009. Price codes: A02 in paper copy, A01 in microfiche. Technical Paper No. 116, July 1987. 14 p, 2 fig, 10 ref.

Descriptors: *Hydrologic models, *Model studies, *Watersheds, *Computer programs, Precipitation, Infiltration, Rainfall-runoff relationships, Runoff, Channel routing, Hydrologic studies, Reservoirs, Simulation analysis, Forecasting, Computers, Flood hydrographs.

The HEC-1 flood hydrographmodel provides a wide range of hydrologic capabilities along with several unique analysis features, for: precipitation, interception/infiltration, transformation of rainfall excess to runoff, channel routing, reservoir routing and dam-break analysis, and pump and diversion capabilities. The current limitations of the model include: (1) The present version of HEC-1 executes in a batch mode, where the user does not have the capability to interface with the program during execution; (2) The program is geared toward single event analysis and does not have the capability to do continuous simulation; (3) Only a single computational time interval may be specified for all hydrologic calculations; (4) Entering data is accomplished by creating an input data file before execution; (5) Channel routing is accomplished by hydrologic methods on a reach by reach basis. Storage effects are not considered dynamically, and downstream backwater problems are not considered during an upstream routing computation; (6) Reservoir analyses are geared toward uncontrolled structures and do not allow for releases based on downstream flow conditions; and (7) Graphics and summary tables are limited to line printer output. Work is being done to overcome several of these limitations. Near-term developments have concentrated on making the operational environment user friendly and improving several of the hydrologic analysis features. (Lantz-PTT)
W88-07740

HYDROLOGY AND SEDIMENT TRANSPORT IN SMALL WATERSHEDS,
Agricultural Research Service, Temple, TX. Grassland, Soil and Water Research Lab.
For primary bibliographic entry see Field 2J.
W88-07829

2B. Precipitation

OXIDATION OF SULFUR DIOXIDE BY OZONE IN HIGHLY DISPERSED WATER DROPLETS,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 2K.
W88-06876

RAINWATER COMPOSITION OVER A RURAL AREA WITH SPECIAL EMPHASIS ON THE SIZE DISTRIBUTION OF INSOLUBLE PARTICULATE MATTER,
Inst. of Meteorology, Univ. of Mainz, Saarstrasse, 21, D-6500 Mainz, FRG.
L. Schutz, and M. Kramer.
Journal of Atmospheric Chemistry, Vol. 5, No. 2, p 173-184, June 1987. 7 fig, 1 tab, 20 ref.

Descriptors: *Air pollution, *Path of pollutants, *Particle size, *Fallout, *Regional analysis, *Rainfall, *Spatial distribution, *Particulate matter, Greenfield Gap, West Germany, Urban areas, Aerosols, Scavenging.

The rainwater composition in the vicinity of Mainz, West Germany, has been investigated with special emphasis on insoluble constituents. The number size distribution was determined in the range from 0.1 microns up to 100 microns radius. For particles with $r > 0.5$ microns radius the shape of the size distribution of insoluble particles in rain follows the shape of the average urban and rural aerosol. In this particular size range no major size selective removal processes could be seen. For $r <$ 0.5 microns the number size distributions tends to flatten compared to the average aerosol. This might be the indication of a size selective removal process (Greenfield Gap). (Author's abstract)
W88-07051

PH OF RAINFALL IN THE CITY OF SANTANDER (SPAIN),
Department of Fundamental and Medical Physics, University of Santander, Santander, Spain.
L. S. Quindos, A. Bonet, D. Diaz-Caneja, P. L. Fernandez, and I. Gutierrez.
Environment International ENVIDV, Vol. 12, No. 5, p 555-558, 1986. 4 fig, 8 ref.

Descriptors: *Acid rain, *Precipitation, *Rainfall, *Sulfates, *Spain, *Meteorological variables, *Meteorology, Hydrogen ion concentration, Atmospheric cleansing, Atmospheric stability.

Values of the pH were measured in rainfalls in 1983 in the city of Santander, Spain. A simple study was made of some meteorological variables as well as the correlations of the pH values with the SO2 levels in air. Daily collections of 66 rainwater samples were measured for pH. Using standard classification criteria, 28.5% were acidic (pH $<$ 5.6), 21.5 were normal (ph 5.6-6.0) and 50% were alkaline (pH $>$ 6.0). The study of two periods (one very unstable and one moderately stable) covering several days of rainfall revealed lower pH and SO2 concentrations in the air after the unstable period, indicating the importance of atmospheric cleansing over short periods of time. (Miller-PTT)
W88-07123

ACID DROPS PROJECT: POLLUTION MONITORING BY YOUNG PEOPLE,
Field Studies Council, Epping Forest Conservation Centre, High Beach, Loughton, Essex IG10 4AF.
C. H. Thomson.
Biological Journal of the Linnean Society BJLSBG, Vol. 32, No. 1, p 127-135, September 1987. 3 fig, 8 ref.

Descriptors: *Acid rain, *Pollution monitoring, *Education, *Research, *Public participation, Rainfall, Research studies, Weather data.

An innovative and ambitious project was launched by the Advisory Centre for Education (ACE), Cambridge, in 1971. Following publicity in a Sunday Times article, 10,000 Clean Water Kits were distributed to young people throughout the U.K. Each kit contained the necessary study material to identify chosen freshwater indicator species, such as stonefly nymphs, freshwater shrimps and blood worms. Using these bioindicators and notes on the presence or absence of fish, clean water streams were distinguished from three other categories of polluted water. The success of the ACE surveys gave rise to a permanent young people's environmental club called 'Watch', which is now the junior wing of the Royal Society for Nature Conservation. The sheer numbers and enthusiasm of young, environmentally concerned people, makes possible the gathering of information on a far wider scale than can be professionally achieved. Two thousand kits were distributed, and an estimated 10,000 young people were involved in collecting acid rain records during January and February 1985. Fifty percent of record forms were completed, less than the 80% for the Clean Water project, but considerably more than the 10% for the Air Pollution project, suggesting a high level of interest and conscientiousness. The Acid Drops survey successfully demonstrated the general meteorological link with acidity patterns over the U.K., using a standard technique of known error, and on a wider scale than was previously possible. (Alexander-PTT)
W88-07129

GASEOUS POLLUTANT AND ACIDIC RAIN IMPACTS ON CROPS IN THE UNITED STATES: A COMPARISON,
National Acid Precipitation Assessment Program, Washington, DC.
For primary bibliographic entry see Field 5B.
W88-07148

GROWTH PARAMETER AND YIELD COMPONENT RESPONSE OF FIELD CORN TO SIMULATED ACID RAIN,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W88-07176

STATISTICAL APPROACH OF THE ARIDIFICATION PROCESS IN WESTERN AFRICA (APPROCHE STATISTIQUE DE L'ARIDIFICATION DE L'AFRIQUE D L'OUEST),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France).
P. Hubert, and J.-P. Carbonnel.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 165-183, 15 November 1987. 9 fig, 1 tab, 44 ref.

Descriptors: *Desertification, *Climate change, *Climatic data, *Climatology, *Arid climates, *Statistical analysis, *Africa, *Rainfall, Regression analysis, Weather data collections, Meterological data collection, Hydrology, Niger, Mali, Burkina Faso, Senegal, Gambia, Cape Verde, Mathematical models.

The statistical study of 42 rainfall series from Niger to Senegal, the length of which is between 37 and 97 years, points out the nonstationarity of these series and suggests a climatic jump about 1969-1970. An integrated autoregressive model of order (p, 1, 0) can be fitted to most of these series but such a model remains useless for operational purposes. Some climatological, meterological, and hydrological consequences are discussed. (Author's abstract)
W88-07200

DISAGGREGATION OF DAILY RAINFALL,
Pima County Department of Transportation and Flood Control, 1313 S. Mission Road, Tucson, AZ 85713.
J. Hershenhorn, and D. A. Wollhiser.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 299-322, 30 November 1987. 21 fig, 2 tab, 21 ref.

Descriptors: *Rainfall, *Rainstorms, *Temporal distribution, *Mathematical models, *Rain gages, Rainfall infiltration, Rainfall-runoff relationships, Surface runoff, Rainfall simulation, Statistical analysis, Arizona.

Greater emphasis is being placed on the use of physically-based infiltration models to estimate surface runoff, and these models are sensitive to the distribution of rainfall amounts in time periods as short as 5 min.; however, such data are not always readily available. A parameter-efficient model for disaggregating daily rainfall into individual storms is presented. This model allows simulation of the number of rainfall events (storms) in a day, and the amount, duration, and starting time of each event, given only the total rainfall on that day and on the preceding and following days. Twenty-three years of data for July and August, from a gage on the Walnut Gulch Experimental Watershed, were used to find the appropriate model structure and to estimate parameters. Statistical tests indicate that simulated sequences of storms compare favorably with observed sequences, and that the disaggregation model structure and parameters identified for one gage provide a satisfactory fit for three stations within a 121-km radius where elevation differs by as much as 244 m, and mean annual rainfall differs by up to 76 mm. (Author's abstract)
W88-07208

COMBINED HYDROLOGIC SAMPLING CRITERIA FOR RAINFALL AND STREAMFLOW,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W88-07209

FIELD INVESTIGATIONS OF THE NATURE OF WATER-TABLE RESPONSE TO PRECIPITATION IN SHALLOW WATER-TABLE ENVIRONMENTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
K. S. Novakowski, and R. W. Gillham.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 23-32, January 15, 1988. 7 fig, 1 tab, 4 ref.

Descriptors: *Infiltration, *Groundwater recharge, *Recharge, *Water table rise, *Capillary zone, *Rainfall infiltration, *Groundwater level, On-site studies, Hydraulic gradient, Capillary water, Geohydrology, Tensiometers, Simulated rainfall, Shallow water.

Several water-table response tests performed in undulating topography at a field site near Chalk River, Ontario were analyzed to gather detailed field information on the nature of the water-table rise in response to precipitation in a shallow water-table environment. The tests were performed by applying simulated rainfall to a study site instrumented in detail with porous membrane tensiometers. Changes in hydraulic head were measured using a pressure transducer and a hydraulic switch. A disproportionate rise in the water table was observed in areas where the zone of tension saturation (capillary fringe) extended to ground surface. For example, for rainfall of 5 mm over a duration of 5.3 min, the water table in the lowest-lying areas rose about 13 cm while the rise in the area of higher ground was only 5 cm. As a result of the difference in response between the low-lying and higher ground, complex and transient hydraulic gradients were established directed away from the low-lying area. The magnitude of the response in the low-lying area can only be explained by the presence of the capillary fringe. (Author's abstract)
W88-07295

PROBABLE MAXIMUM PRECIPITATION FOR DESIGN FLOODS IN THE UNITED STATES,
National Weather Service, Silver Spring, MD. Office of Hydrology.
E. M. Hansen.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 267-278, December 1987. 4 fig, 1 tab, 12 ref.

Descriptors: *Design floods, *Probable maximum precipitation, *Maximum probable floods, *Rainstorms, *Flood data, Depth-area-duration analysis, United States, Orographic precipitation.

The usage of probable maximum precipitation (PMP) estimates as a basis for determining the probable maximum flood (PMF) for use in hydrologic design is approaching 50 years in the U.S. The foundation for determining the level of PMP is the extreme storm record and the concepts of storm maximization, transposition and envelopment. Modifications to the procedure have continued to evolve over this period. Concepts of within-storm precipitation, preferred isohyetal pattern orientation and concurrent precipitation into basins outside the primary drainage of the PMP storm have been developed during the last 10 years. The most recent work in determining PMP for highly orographic regions is briefly outlined. Current practice in the U.S. is to evaluate the level of PMP through comparison studies with observed storm amounts and other rainfall indices. (Author's abstract)
W88-07404

STUDY OF DESIGN STORMS IN CHINA,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
J. Wang.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 279-291, December 1987. 6 fig, 2 tab, 4 ref.

Descriptors: *Depth-area-duration analysis, *Design storms, *Design floods, *Probable maximum precipitation, *Rainstorms, *China, *Frequency analysis, Storms.

A study of design storms mainly involves frequency analysis of point rainfall, depth-duration relationships, depth-area relationships and storm patterns. Depth-area-duration analyses based 1,000 storm events were performed for most of China, and have made it possible to develop design storms and the basis of adequate data analysis. This paper discusses the application of some effective methods used in China, e.g. the full use of storm data (including data from field investigation), storm data regionalization, development of isoline maps of statistical parameters of different durations, study of the 'fixed-point to fixed-area relationship' and evaluation of Probable Maximum Precipitation. (Sand-PTT)
W88-07405

DETERMINISTIC APPROACH TO INFLOW DESIGN RAINFLOOD DEVELOPMENT AS APPLIED BY THE U.S. BUREAU OF RECLAMATION,
Flood Section, U.S. Bureau of Reclamation, PO Box 25007, Denver, CO 80225.
For primary bibliographic entry see Field 2A.
W88-07406

ANALYSIS OF THE DESIGN STORM TIME-INTENSITY PATTERN FOR MEDIUM AND SMALL WATERSHEDS,
Hydrological General Station of Guangdong Province, Canton (P.R. of China).
W. C. Qian.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 305-317, December 1987. 4 fig, 6 tab, 5 ref.

Descriptors: *Design storms, *Design floods, *Rainfall distribution, *Rainstorms, *Watersheds, *Flood data.

For medium and small watersheds (area <1,000 sq km), due to a lack of observed discharge data, the design flood is generally derived from the design storm. The traditional method is to assume that the design storm has the same frequency as the design flood. The present method for the computation of the design storm is based on point precipitation, and only the recurrence frequency of annual maximum values for various durations is considered. The distribution of storm rainfall among various durations during the course of a storm has not been well studied, and the correlation between storms and the associated floods has not been done either. In order to analyze the method commonly used in practice for the derivation of the design storm pattern, three hydrological stations with different control areas were selected. Based on the areal average rainfall and an analysis of the correlation between storms and floods, a reasonable method for determining the design storm pattern can be obtained. This analysis showed that it is reasonable to synthesize and select the design storm pattern for medium and small watersheds from the areal storm pattern corresponding to the observed major floods for watersheds of similar size, and then to derive the storm pattern by controlling the subsegments which have the same frequency. Because it is inconvenient to have too many control durations, the minimum control duration should be selected on the basis of lag time, m1, of a unit hydrograph. For the selection of a typical storm, the uniformity of the spatial distribution of the storm should be noticed. For a watershed >500 sq km, the spatial distribution of rainfall should be considered in designing the storm pattern. (Author's abstract)
W88-07407

DETERMINATION OF DESIGN FLOODS USING STORM DATA,
Corps of Engineers, Washington, DC.
E. A. Stallings.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 319-328, December 1987. 2 fig, 2 tab, 14 ref.

Descriptors: *Design floods, *Flood data, *Spillways, *Hydraulic design, *Reservoir design, *Probable maximum precipitation, *Rainstorms, Catchment areas, Hydrographs, Safety, Flood routing, Snowmelt, Economic aspects.

A brief historical perspective of hydrologic analyses used in the determination of spillway sizing is presented. The procedures for determining a reasonable upper limit of flood potential for a given drainage basin is described. A previous paper by the National Weather Service detailed the development of probable maximum precipitation estimates. These estimates form the basis for the determination of spillway design floods which are used to size spillways of major reservoirs for the U.S. Army Corps of Engineers. Nationwide, the Corps has constructed hundreds of reservoirs which are operated for flood control, navigation, hydroelectric power and other purposes. These reservoirs are sized based on storm data and must withstand the most severe flood likely to occur. The design data include antecedent storms, infiltration, unit hydrographs and other spillway design floods. Emphasis is on designing safe reservoirs vs. design flood selection based on economical considerations. A brief discussion of the similarities of design floods used by other Federal construction agencies is presented. (Author's abstract)
W88-07408

RESEARCH ON STATISTICAL ESTIMATION OF STORM TRANSPOSITION,
Northwest China Hydroelectric Investigation and Design Institute, Ministry of Water Resources and Electric Power, Xian, Shaanxi Province (P.R. of China).
For primary bibliographic entry see Field 2E.
W88-07410

STUDY OF THE RELATIONSHIP BETWEEN STORM RAINFALL AND FLOOD BASED ON ANALYSIS OF THE '83.7' FLOOD AT ANKANG IN THE HAN RIVER BASIN,
Haihe River Water Conservancy Commission, MWREP, Tianjin (P.R. of China).
For primary bibliographic entry see Field 2E.
W88-07411

DESCRIPTION OF LOW- AND HIGH-ACID PRECIPITATION,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
E. S. Verry, and A. R. Harris.
Water Resources Research WRERAO, Vol. 24, No. 4, p 481-492, April 1988. 12 fig, 5 tab, 32 ref.

Descriptors: *Model studies, *Acid rain, *Water chemistry, *Water pollution sources, *Cations, Ions, Acids, Acidity, Rainfall, Statistical analysis, hydrogen ion concentration.

A model was developed to group precipitation samples from any location into four strata that represent collections of similar chemistry. Logic and cation frequency were used first to define low- and high-salt samples, and then regression analysis was used to define low- and high-H samples. Low-H concentrations ranged between 0 and 13 micro-eq/L. Hydrogen regressed on the sum of NO3 + SO4 showed two consistent equations: one for normal H concentrations and one for emission-related, high-H concentrations. Delta analysis (the change in concentration between group means) and analysis of regression residuals between ion pairs and a third common ion revealed strong correlations for H:NO3, H:SO3, NH4:SO4, and Na:Cl in low-salt, highly acid precipitation samples. Hydrogen, SO4, NO3, and NH4 compose 95% of acid precipitation chemistry in the United States. Significant correlations for NH4:NO3 and all other ion pairs did not exist in samples from highly acid, low-salt collections. Nitrate and SO4 carried H at average portions of 36 and 64%, respectively, regardless of H concentrations. Variation in these portions of + or - 15% was site specific and not a function of H concentration. (Author's abstract)
W88-07438

EVALUATION OF THE EQUILIBRIUM CALCULATIONS WITHIN ACIDIFICATION MODELS: THE EFFECT OF UNCERTAINTY IN MEASURED CHEMICAL COMPONENTS,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W88-07443

DEUTERIUM IN WATER VAPOR ABOVE THE ATMOSPHERIC BOUNDARY LAYER,
City Coll., New York. Dept. of Earth and Planetary Sciences.
S. D. Gedzelman.
Tellus TELLAL, Vol. 40B, No. 2, p 134-147, April 1988. 13 fig, 2 tab, 26 ref. NSF ATM Grants 81 16371 and 83 13954.

Descriptors: *Model studies, *Isotope studies, *Atmospheric physics, *Deuterium, *Water vapor, Prediction, Tracers, Weather.

A model for the isotopic composition of water vapor above the atmospheric boundary layer includes the effects of isotope fractionation and vertical turbulent transport of vapor. It utilizes an assumed air trajectory in which an air parcel initially acquires water vapor over the ocean, rises dry and then moist adiabatically, and finally sinks to the observed conditions of height, temperature and dew point temperature. Discrepancies between model predictions and actual profiles are shown to have characteristic signatures which render the isotopic composition of water vapor of potential value as a dynamic tracer of atmospheric processes and motions. (Author's abstract)
W88-07479

ORIGIN AND COMPOSITION OF SAMOAN ACID PRECIPITATION,
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
For primary bibliographic entry see Field 5B.
W88-07480

MODELLING EXTREME RAIN SEQUENCES IN ZAMBIA,
Department of Water Affairs, P.O. Box 772, Maseru 100 (Lesotho).
T. C. Sharma.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 101-111, August 15, 1987. 4 fig, 3 tab, 13 ref.

Descriptors: *Rainfall intensity, *Mathematical models, *Statistical analysis, *Intensity-duration-return period, *Rainfall, Zambia, Precipitation, Model studies, Probabalistic process.

The annual maximum daily rainfall sequences and rainfall intensities ranging from 5 min to 24 h duration in Zambia were subjected to statistical analyses. The annual maximum daily rainfall sequences can be modelled satisfactorily using the extreme value type 1 distribution to obtain extreme daily rainfall magnitude versus return period relationships. The annual maximum rainfall intensities for varying durations fit satisfactorily the extreme value type 1 distribution. The rainfall intensity-duration-return period interactions fitted a power law relationship. (Author's abstract)
W88-07528

USE OF CROSS-CORRELATION ANALYSIS IN STUDIES OF PATTERNS OF RAINFALL VARIABILITY,
R. Berndtsson.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 113-134, August 15, 1987. 8 fig, 26 ref.

Descriptors: *Correlation analysis, *Rainfall, *Mathematical studies, *Spatial distribution, *Rainfall distribution, *Topography, Precipitation, Tunisia, Statistics.

Cross-correlation structures based on daily rainfall data recorded during a period of 5 years at 67 stations throughout Tunisia were used to examine spatial rainfall variability. Basic properties of the correlation-distance function such as cumulating period, exclusion versus inclusion of dry periods, and data volume were analyzed. Analysis of the correlation patterns for each month showed that two periods (February-May, and September-November) are delimited by a period of great instability (December-January) and by the dry period (June-August). Three main rainfall regions could be distinguished, delimited and governed mainly by the topography and the coastal influence. (Author's abstract)
W88-07529

STORM TRACKING USING RAIN GAUGE DATA,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
J. Niemczynowicz.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 135-152, August 15, 1987. 6 fig, 2 tab, 27 ref.

Descriptors: *Rainfall distribution, *Rain gages, *Storm runoff, *Forecasting, *Rainfall-runoff relationships, Sweden, Hydrographs, Precipitation, Regional variation.

The unknown spatial distribution and kinematics of short-term rainfall are recognized as the most important reasons for errors in runoff simulation on urban catchments. Since the storm movement influences the shape of the runoff hydrographs, modern rainfall input should include patterns of this movement. In order to be able to take rainfall kinematics into account in runoff simulation, rain movement parameters must be extracted from the rainfall data itself or taken from other phenomena such as wind movement at high altitude. Three different storm tracking methods were applied to a set of rainfall data from the 12-gauge network in Lund, Sweden. The main conclusion is that a really objective and reliable storm tracking method does not exist yet. When more than one rainfall cell is simultaneously present over the rain gauge network, all so-called objective methods fail or must lose their objectivity. On the other hand, when the rainfall data are good, the storm movement pattern can be easily, though subjectively, recognized. Then, simple methods based on triangulation work equally well as more sophisticated methods based on spatial correlation. The existence of a relation between rainfall and high-altitude wind movement parameters is well documented. However, further studies subjected to derivation of storm movement parameters from gauge data are still important in order to quantify this relationship better and to explain eventual regional differences. (Author's abstract)
W88-07530

RAINFALL VARIATIONS IN THE GALILEE (ISRAEL): I. VARIATIONS IN THE SPATIAL DISTRIBUTION IN THE PERIODS 1931-1960, AND 1951-1980,
Haifa Univ. (Israel). Dept. of Geography.
H. Kutiel.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 331-344, October 30, 1987. 4 fig, 2 tab, 19 ref.

Descriptors: *Rainfall, *Israel, *Seasonal variation, *Rainfall distribution, *Rainfall intensity, Spatial distribution, Data interpretation, Trend surface analysis, Galilee.

Mean monthly rainfall from different stations in the Galilee (northern Israel) for the periods 1931-1960 and 1951-1980, have been correlated with longitude, latitude and altitude of each station. A seasonal pattern of the explained variance by each of the variables has been found. At the beginning of the rainy season, the rainfall is correlated most strongly with the longitude of the stations, during the main rainy season with the altitude and at the end of the rainy season with the latitude of the stations. In the period 1951-1980 the correlation with latitude was weaker than in the period 1931-1960. The decrease in the correlation may be attributed to a shift in the depressions' tracks in the Eastern Mediterranean and to cloud seeding. A trend surface analysis of the isohyetal orientation reflects the same seasonal pattern: a shift from a mainly N-S orientation at the beginning of the rainy season, to a mainly E-W or even ESE-WNW orientation at the end of it. (Author's abstract)
W88-07584

ANALYSIS OF SULFUR-CONTAINING COMPONENTS OF A SOIL TREATED WITH SIMULATED ACID RAIN,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-07588

AEROSOL AND CLOUDWATER PROPERTIES AT WHITEFACE MOUNTAIN, NEW YORK,
National Oceanic and Atmospheric Administration, Boulder, CO. Air Resources Lab.
For primary bibliographic entry see Field 5B.
W88-07596

PEATLAND WATER CHEMISTRY IN CENTRAL ONTARIO IN RELATION TO ACID DEPOSITION,
Canadian Wildlife Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W88-07599

CHEMICAL COMPOSITION OF HOARFROST, RIME AND SNOW DURING A WINTER INVERSION IN UTAH, U.S.A.,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W88-07605

DESIGN AND USE OF A COLLECTOR FOR THE IN SITU ISOLATION OF PARTICULATE TRACE ORGANIC SPECIES IN PRECIPITATION,
Oregon State Univ., Newport. Hatfield Marine Science Center.
For primary bibliographic entry see Field 5A.
W88-07614

SIMULATED ACID RAIN AND THE IMPORTANCE OF ORGANIC LIGANDS ON THE AVAILABILITY OF ALUMINUM IN SOIL,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 5B.
W88-07615

ACIDIFICATION TRENDS IN SWEDEN,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 5B.
W88-07617

TRACE METALS IN PRECIPITATION IN SWEDEN,
Dept. of Meteorology, Univ. of Stockholm, S-106 91 Stockholm, Sweden.
For primary bibliographic entry see Field 5B.
W88-07619

OBJECTIVE ANALYSIS OF MONTHLY CLIMATOLOGICAL FIELDS OF TEMPERATURE, SUNSHINE, RAINFALL PERCENTAGE AND RAINFALL AMOUNT,
Meteorological Service, Glasnevin Hill, Dublin 9, Ireland.
J. E. M. Hamilton, P. Lennon, and B. O'Donnell.
Journal of Climatology JOUCD2, Vol. 8, No. 2, p 109-124, March-April 1988. 10 fig, 1 tab, 17 ref.

Descriptors: *Model studies, *Climatology, *Weather data collections, *Rainfall, *Mapping, *Computer programs, *Temperature, Stochastic process, Mathematical studies, Simulation, Ireland, Least squares method, Interpolation, Quadratic approximation.

An objective method of drawing climatological maps of sunshine, temperature, rainfall percentage and rainfall amount, which is used operationally at the Irish Meteorological Service in Dublin, is described. The interpolation is based on McLain's method of distance weighted least squares quadratic approximation. The observations are interpolated directly to a regular (rectangular) mesh, without the use of a first-guess, and the resultant field is contoured and shaded using a standard contouring package. This basic interpolation gave some spurious results near the coast and in data void areas when it was applied in its original form. These problems were overcome by the introduction of dummy values in such regions and a method was developed for calculating such values automatically based on nearby observations and various climatological normals. The method has been in operational use since February 1985 and the results are of quality comparable to the manual method which this computer method had replaced. (Author's abstract)
W88-07627

DEVELOPMENT PROCESSES FOR FIVE DEPRESSION SYSTEMS WITHIN THE POLAR BASIN,
Waterloo Univ. (Ontario). Dept. of Geography.
E. F. Ledrew.
Journal of Climatology JOUCD2, Vol. 8, No. 2, p 125-153, March-April 1988. 19 fig, 1 tab, 38 ref.
NSF Grant No. DPP-85-20883 and ONR Contract N00014-83-C-0070.

Descriptors: *Climatology, *Model studies, *Atmospheric physics, *Polar regions, *Advection, *Air currents, *Baroclinicity, Thermal conductivity, Arctic, Weather, Latent heat, Energy, Arctic zone, Greenland, Asia, Feedback.

Five synoptic sequences in the Polar Basin are studied on a day by day basis. A diagnostic model is used to illustrate the relative roles of the dynamic properties of the advected air flow in comparison to mechanisms related to the characteristics of the underlying surface. The properties of the advected air flow are the major contribution to the vertical circulation associated with synoptic evolution and are a necessary condition. Latent heat release may also be a significant mechanism which supports the proposal by others that a CISK type process may contribute to further development in the Arctic. The surface sensible heat flux is not a necessary process and it may at times oppose the vertical circulation when warm air is advected into the region of development within the circulation of the depression. The surface frictional effect is a minor contribution within the central Polar Basin but is a significant process in systems migrating along the Asiatic coastline. A feedback linkage between synoptic evolution and intensification of the baroclinicity is proposed in the Greenland region for a cold low type of vortex. A cold pool, apparently created by intense radiative cooling over Greenland, was identified in early July. There was significant advective convergence associated with the thermal gradients which contributed to synoptic development as the depression migrated around this pool. It appears that the intensification of the potential temperature gradient with the advection maintained the baroclinicity, despite warm air advection into the center of the pool. This is an interesting feature which requires further study and confirmation. (Author's abstract)
W88-07628

SYNOPTIC CLIMATOLOGICAL ANALYSIS OF RAINFALL VARIABILITY IN SOUTH-EASTERN AUSTRALIA,
Dept. of Geography and Cainozoic Research Unit, Monash Univ., Clayton, Victoria 3168, Australia.
P. H. Whetton.
Journal of Climatology JOUCD2, Vol. 8, No. 2, p 155-177, March-April 1988. 11 fig, 53 ref.

Descriptors: *Climatology, *Rainfall variability, *Principal component analysis, *Barometric pressure, *Weather data collections, *Regional analysis, *Mathematical studies, *Rainfall, *Australia, Atmospheric physics, Wind, Weather.

Monthly rainfall data for the state of Victoria in south-eastern Australia were analyzed using principal component analysis and Varimax orthogonal rotation, with the intention of revealing typical patterns of rainfall variability. Two data sets were used: a spatially detailed set for 1970-1980, and a less spatially detailed set for 1905-1980. The first five rotated principal component patterns (RPCPs) produced from the two data sets showed the same structure. These five RPCPs each dominated rainfall over a particular sub-region, and the climatic regionalization that this suggested appeared to be one strongly determined by topography. The anomalies of Australian region mean monthly mean sea-level (MSL) pressure associated with these five RPCPs of rainfall were determined using correlational techniques. Of the five main RPCPs of rainfall, the pattern based in the south-west of the state showed the strongest relationship with monthly pressure anomalies, and was associated with the occurrence of onshore westerly winds. The results for the rainfall pattern based in northern Victoria were perhaps the most interesting. Rainfall in this region was related to the occurrence of anomalous northerly winds through south-eastern Australia, although through the cooler months of the year these winds accompanied a low pressure anomaly centered over central Australia, whereas in the warmer months they were associated with a high pressure anomaly centered to the south-east of the continent. This northern rainfall pattern also showed some month to month persistence, and a distinct correlation with the Southern Oscillation. (Author's abstract)
W88-07629

CHANGES IN PRECIPITATION CONDITIONS IN THE WESTERN MEDITERRANEAN OVER THE LAST CENTURY,
Inst. of Meteorology and Climatology, Aristotelian Univ. of Thessaloniki, Greece.
P. Maheras.
Journal of Climatology JOUCD2, Vol. 8, No. 2, p 179-189, March-April 1988. 3 fig, 1 tab, 32 ref.

Descriptors: *Climatology, *Weather data collections, *Mathematical studies, *Rainfall, *Mediterranean, *Time series analysis, Seasonal variation, Weather, Weather patterns, Principal component analysis.

A study of precipitation variations over the western Mediterranean is given, for a period of 95 years (1891 to 1985), based on the use of Principal Component Analysis. The curves for the scores are traced and then analyzed for annual as well as seasonal precipitation. Two principal moist periods are found (1901 to 1921 and 1930 to 1941) and two principal dry periods (1922 to 1929 and 1941 to 1954). A comparison of variations in precipitation and zonal indices indicates that with a meridional circulation dominating over the western Mediterranean, there is increase in precipitation; with a zonal circulation dominating there is decrease in precipitation. (Author's abstract)
W88-07630

VARIABILITY OF MEAN MONTHLY TEMPERATURES AND SEMI-ANNUAL PRECIPITATION TOTALS IN EUROPE IN RELATION TO HEMISPHERIC CIRCULATION PATTERNS,
Dept. of Meteorology, Climatology and Hydrology, Univ. of Lodz, Kosciuszki 21, 90-418 Lodz, Poland.
K. Kozuchowski, and K. Marciniak.
Journal of Climatology JOUCD2, Vol. 8, No. 2, p 191-199, March-April 1988. 4 fig, 1 tab, 18 ref.

Descriptors: *Climatology, *Weather data collections, *Atmospheric circulation, *Mathematical studies, *Europe, *Weather patterns, *Rainfall, *Maps, Wind, Temperature, Weather, Atmospheric physics, Zonal index, Prediction.

The influence of general hemispheric circulation on European temperature and precipitation was investigated. Data from the period 1901-1976 were utilized: the monthly frequencies of occurrence of W, E, C circulation pattern types according to the Wangeheim-Girs classification, monthly values of pressure differences between 35 deg and 65 deg N (zonal index), mean temperatures of January and July at 30 stations in both the warm season (May-October) and the cold season (November-April) and semi-annual precipitation totals for 21 stations in Europe. The correlation coefficients between the circulation characteristics and climate elements indicated above in Europe were calculated. Maps of these correlation coefficients were produced, with the areas of their statistical significance. The results show that variability of temperature, and also partly of precipitation in Europe are significantly correlated with changes of circulation pattern types. January temperature also depends on the zonal index. If it is assumed that in future, until the end of this century, an increase of W type frequency and a decrease of C circulation pattern types will take place. Northern and some central areas of Europe are likely to change from continental to oceanic climate as regards temperature; precipitation is likely to increase in northern Europe. (Author's abstract)
W88-07631

PRECIPITATION ACIDITY AT A RURAL SITE IN NORTH WALES,
Institute of Terrestrial Ecology, Bangor, Gwynedd, Wales.
B. Reynolds.
Weather WTHRAL, Vol. 42, No. 8, p 236-240, August, 1987. 5 fig, 3 tab, 6 ref.

Descriptors: *Water pollution sources, *Chemistry of precipitation, *Acid rain, *Wales, *Rural areas, *Data collections, Rainfall, Chemical properties, Hydrogen ion concentration, Distribution, Frequency distribution, Acidity.

Daily rainfall data are presented for a year at a rural site in North Wales. Analysis of the data has identified some of the factors affecting rainfall acidity at the site and confirms observations made at other sites in the UK. Total rainfall between June 1, 1984 and May 31, 1985 was 1,405 mm with 127 rain days. The rainfall weighted mean pH for the period was 4.73, with the most acid rainfall having a pH of 3.46. There is a general inverse relationship between hydrogen ion concentration and rainfall amount. Rainfall was less episodic than deposited acidity, indicating that the episodicity of hydrogen ion deposition cannot be explained simply by the rainfall pattern. Six days were responsible for 30% of the deposition; they were characterized by very high acidity and low rainfall, possibly caused by precipitation along a frontal zone at the periphery of a polluted air mass. Two days were characterized by lower acidities but relatively large amounts of rain, possibly caused by slow-moving frontal systems where convergence of moist low-level air produced heavy and prolonged rainfall. A study of 48-hr back trajectories for the days of highest deposition indicates that continental sources may contribute to pollution in Britain. (Doria-PTT)
W88-07644

RAINDROPS, AIR POLLUTION AND BURSTING BUBBLES,
Ecole Nationale Superieure de Techniques Avancees, Paris (France).
For primary bibliographic entry see Field 5B.
W88-07645

INFLUENCE OF THE TIDE ON RAINFALL IN A TIDAL AREA,
Institute of Earth Sciences, Amsterdam.
H. F. Vugts.
Weather WTHRAL, Vol. 42, No. 11, p 342-346, November, 1987. 2 fig, 1 tab, 3 ref.

Descriptors: *Tidal effects, *Rainfall, *Tidal flats, *Estuaries, Weather, Tides, Temperature, Rainfall intensity, Depth-area-duration analysis, Distribution, Annual distribution.

Meteorological variables were analyzed from a station on the 'Wadden' islands in the northern Netherlands to investigate the observation that thunderstorms (usually from the south) do not cross the tidal flats when there is a high tide. Air temperature, relative humidity, windspeed and direction, rainfall, sunshine, global radiation, and air pressure were measured between September, 1971 and August, 1985. To detect any significant influence of tidal flats on the depth and duration of rainfall, data were divided into four groups using the parameters high tide (HT), low tide (LT), wind from the mainland (LB), and wind from the North Sea (SB), resulting in the combinations HTLB, HTSB, LTLB, and LTSB. For each month, the difference in rainfall depth and duration was calculated between the situations HTLB and LTLB. Data were checked by 'reverse investigations' and controls. It is concluded that both rainfall depth and intensity are influenced by tides on the island of Shiermonnikoog. (Doria-PTT)
W88-07646

HOW OFTEN DOES IT RAIN WHERE YOU LIVE,
N. J. Doesken, and W. P. Eckrich.
Weatherwise WTHWA2, Vol. 40, No. 4, p 200-203, July-August, 1987. 4 fig, 1 tab.

Descriptors: *Rainfall distribution, *Weather, *Precipitation, *Climatology, Distribution, Annual distribution, United States, Temporal distribution.

Although data on average annual precipitation amounts for different regions are readily available, what really matters for human comfort and scheduling is how often it precipitates and at what time of day. Published National Weather Service summaries for the 1951-1960 period were used to determine the average annual hours of precipitation for 100 selected major cities and airports in the United States. The percentage of total hours with measurable precipitation in an average year was determined. The majority of the country has measurable precipitation in less than 6% of an average year; Portland, Oregon has the highest frequency (11.5%). Moderate and heavy precipitation occur much less frequently than light precipitation, with 0.1 in or more/hr occurring >1% of the time only in the eastern half of the country. The most heavy rain hours were found in New Orleans, Charleston (SC), and Miami. Trace amounts of precipitation occur more often than measurable amounts over most of the country. Patterns of precipitation frequency are discussed. It is concluded that perception of climate is often dominated more by frequency than by amount. (Doria-PTT)
W88-07647

SIMPLE MOIST MODEL RELEVANT TO THE ORIGIN OF INTRASEASONAL DISTURBANCES IN THE TROPICS,
Research Institute for Applied Mechanics, Kyushu University, Kasuga 816, Japan.
T. Yamagata.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 2, p 153-165, April, 1987. 8 fig, 38 ref, 2 append. Japan Min. Educ. Sci. Culture Contract No. 61302024.

Descriptors: *Model studies, *Atmosphere physics, *Meteorology,matology, *Tropic zone, *Weather, Convection, Shallow water, Mathematicaltions, Temperature, Climatic zones, Wind, Buoyancy, Heating, Cyclones, Storms.

A simple moist model of some basic properties relevant to the origin of the intraseasonal disturbances in the tropics was constructed by use of the linear shallow-water equations on a sphere. The mutual interaction of equatorial dynamics and convective activity was demonstrated by releasing localized, initial anomalies for either temperature or velocity. It was found that there are two intrinsic ways of large-scale moist adjustment processes in the tropics. First, it was shown that the active heating region associated with the convergence of low-level winds propagates eastward spontaneously with expansion of the zonal scale of the velocity field. The phase speed of this organized pattern is much smaller than that reduced by the convergence-dependent heating. These results are consistent with recent studies of the 30-50 day oscillation in the tropics. Second, the model also demonstrates that the burst of westerly winds may excite a westward propagating cross-equatorial cyclone pair more easily than the burst of easterly winds. This vortex pair is mainly composed of the gravest Rossby waves with moist processes and is quite similar to the long-lived synoptic cyclone pair often observed over the warm SST region in the tropics. (Author's abstract)
W88-07681

SIMULATION OF THE TROPOSPHERIC GENERAL CIRCULATION WITH THE MRI ATMOSPHERIC GENERAL CIRCULATION MODEL: PART III. THE ASIAN SUMMER MONSOON,
Meteorological Research Institute, Tsukuba, Ibaraki 305, Japan.
A. Kitoh, and T. Tokioka.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 2, p 167-187, April, 1987. 14 fig, 2 tab, 37 ref, append.

Descriptors: *Atmospheric physics, *Simulation, *Model studies, *Asia, *Meteorology, *Climatology, *Monsoons, *Weather, Wind, Distribution, Seasonal distribution, Temporal distribution, Flow, Heat flow, Groundwater, Energy.

An Asian summer monsoon simulated by a 5-layer tropospheric general circulation model (MRI-GCM-I) is described. Gross features of the July circulations are well simulated. Although the detailed rainfall distribution in the monsoon region is not well reproduced, the time evolution of the total diabatic heating distribution over the entire monsoon region was reasonably simulated. Quasi-periodic oscillations are found in the model monsoon system. Their time evolution is quite similar to that previously described, although the simulated oscillation period is 8-9 days. The oscillation period seems to be influenced by the dominant quasi-10 day period of Kelvin waves found in the model tropics. As a result, the timing of the monsoon onset coincides with one of the favorable timings for the intensification of the upper level easterlies over the equatorial Indian Ocean provided by the Kelvin wave. Preceding the monsoon onset, a long-lasting westward moving disturbance was formed in the model lower troposphere in the south of the equator over the Indian Ocean. Further studies are needed to confirm the reality of this disturbance and the role of it on the monsoon onset. (Doria-PTT)
W88-07682

INSTANTANEOUS DELINEATION OF CONVECTIVE RAINFALL AREAS USING SPLIT WINDOW DATA OF NOAA-7 AVHRR,
Meteorological Research Institute, Tsukuba, Ibaraki 305, Japan.
T. Inoue.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 3, p 469-481, June, 1987. 14 fig, 2 tab, 25 ref.

Descriptors: *Meteorology, *Convective precipitation, *Rainfall area, *Satellite technology, *Infrared imagery, *Clouds, Precipitation, Remote sensing, Rainfall, Weather, Radar, Statistical analysis.

A feasibility study was conducted of delineation of convective rainfall area using the split window (11 micron and 12 micron) data measured by the Advanced Very High Resolution Radiometer (AVHRR) on board NOAA-7. Non-precipitating cirrus clouds and low-level cumulus clouds, which cause an erroneous rainfall area delineation, are objectively distinguished from cumulonimbus clouds by the split window data. The satellite rainfall areas are defined as those of cumulus and cumulonimbus clouds whose tops are over 700 mb level. The satellite rain-clouds were compared with concurrent radar data for eight cases. The study was performed over the area of 33 deg - 39 deg N and 135 deg - 141 deg E during the summer season in 1984 by taking into account the availability of digital radar data and the atmospheric condition for convective clouds. Statistics show that this method is better than the conventional single infrared method by 12% for the probability of detection and 13% for the false alarm ratio. Significant improvement in rain area delineation by this method in comparison with the single infrared method can be obtained in the situation where single layer cirrus clouds or low-level rain-clouds dominate over the study area. (Author's abstract)
W88-07684

EFFECTS OF SURFACE ROUGHNESS AND POROSITY ON THE RIMING OF SNOWFLAKES,
Meteorological Research Inst., Yatabe (Japan).
T. Matsuo.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 4, p 635-647, August, 1987. 17 fig, 14 ref.

Descriptors: *Porosity, *Rime, *Snow, *Meteorology, *Clouds, *Fluid droplets, Weather, Atmospheric physics.

Collision experiments were conducted with model snowflakes suspended on the end of a needle in a vertical wind tunnel to examine the effects of surface roughness and porosity of snowflakes on their collection efficiency for cloud droplets. The snowflake models were disks with small glass beads attached to their surface (roughness) or rectangular holes evenly spaced on their surface (porosity). The models were exposed to an airflow carrying saline water droplets or spherical glass particles. The effects of roughness and porosity were deduced from counting the numbers of particles captured on the model surface or from analyzing the motion of the particles around the models. It was shown that the collection efficiency was enhanced by these effects, especially in a small inertia region. Very small particles, which could not be scavenged on the basis of impaction theory, were captured by the models owing to these effects. The effect of the porosity generally was larger than that of roughness. It is concluded that actual falling snowflakes can gather more cloud droplets in the smaller sizes than might be expected from traditional impaction theory. (Author's abstract)
W88-07685

DEVELOPMENT OF CLOUD PARTICLE VIDEO SONDE,
Meteorological Research Institute, Tsukuba, Ibaraki 305, Japan.
M. Murakami, T. Matsuo, T. Nakayama, and T. Tanaka.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 5, p 803-809, October, 1987. 10 fig, 1 tab, 12 ref.

Descriptors: *Remote sensing, *Cloud physics, *Technology, *Weather, Clouds.

A special sonde for measuring cloud particles was developed. The sonde, called a Cloud Particle Video Sonde (CPVS), has a small TV camera, and transmits images of cloud particles from 7 microns to 1,000 microns in diameter over a 1.6 GHz microwave link to a ground station. Observations show that the CPVS provides high-quality images of cloud particles at altitudes up to 12 km MSL. The number concentration of cloud particles and the variation of their size distribution with height can be calculated from the collection efficiency of the CPVS for water droplets as determined from a laboratory experiment. (Author's abstract)
W88-07686

VARIATIONS IN THE ONSET OF THE SUMMER MONSOON OVER INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
I. Subbaramayya, O. S. R. U. Bhanu Kumar, and S. Vivekanandababu.
Meteorological Magazine MTMGA5, Vol. 116, No. 1383, p 309-317, October, 1987. 6 fig, 1 tab, 18 ref.

Descriptors: *Meteorology, *Climatology, *Monsoons, *India, *Temporal distribution, *Snow cover, Wind, Distribution.

The trend and quasi-periodicity of the variability in the onset of the summer monsoon over India were examined for the years 1956 to 1983, using linear regression analysis, power spectrum analysis, satellite-derived monthly mean snow-cover data, and correlation analysis. It was found that there has been a delaying trend in the date of onset over India, and a similar increasing trend in the snow cover over the northern hemisphere, Eurasia, and the Himalayas during 1967-80. These trends are consistent with the decreasing trend in temperature of the northern hemisphere as well as India and the absence of similar trends in temperature in the southern hemisphere observed in the recent past. Power spectra of the onset dates show large power in the 2.0 to 2.5 years which could be associated with the effect of quasi-biennial oscillation. Significant power peaks in the 6- to 8-year period in northwest India and adjoining areas are also present, as in a 16-year period in the south peninsula onset dates. For February snow cover, there is a significant period at 5 years. Snow covers in February show positive correlations with the onset dates, especially in central India. (Doria-PTT)
W88-07687

REMOTE AND IN SITU OBSERVATIONS OF SIERRA NEVADA WINTER MOUNTAIN

CLOUDS: RELATIONSHIPS BETWEEN MESOSCALE STRUCTURE, PRECIPITATION AND LIQUID WATER,
U.S. Bureau of Reclamation, Auburn, California.
D. W. Reynolds, and A. P. Kuciauskas.
Journal of Applied Meteorology JAMOAY, Vol. 27, No. 2, p 140-156, February 1988. 14 fig, 1 tab, 38 ref, append. Bureau of Reclamations Contract 4-CR-81-03860.

Descriptors: *Cloud seeding, *Weather modification, *Cloud physics, *Precipitation, *Storms, *Remote sensing, *Data acquisition, *Sierra Nevada, Clouds, Seasonal variation, *Mountains, *Weather patterns, Winter, Sierra Cooperative Pilot Project, Climatology, Radar, Microwaves, Satellite technology, Supercooling, Rainfall, Weather forecasting, Forecasting, Weather modification, Measuring instruments, Radiometry, Radiosondes.

A small subset of midaltitude, midwinter precipitation events affecting the central Sierra Nevada was analyzed. These examples were representative of 60% of the storm types documented during the past 4 years of the Sierra Cooperative Pilot Project. The structure of the frontal systems was consistent with those observed in the U.S. Pacific Northwest and in the British Isles. Data were collected with the following instruments: vertically pointing microwave radiometer, conventional radar, satellite imagery, and detailed time cross sections of rawinsonde data. The highest concentration of supercooled liquid water occurred after passage of an upper jet with accompanying upper-level front or surface cold anafronts and/or katafronts. These frontal passages led to decreasing cloud thickness, warming cloud tops, decreasing precipitation rate, and shallow embedded convection over the mountain range. Discontinuities in cloud top temperature, rainbands, and decreasing echo height, associated with the passage of the upper jet and accompanying front, was identified with satellite and radar several hours before affecting the Sierra Nevada, thus providing for the onset or increase in supercooled liquid water. These clouds are conducive to seeding because the supercooled liquid water exists in the colder, more convective airmass, which increases the dispersal of seeding materials and increases the activation of the silver iodide nucleant. (Cassar-PTT)
W88-07691

RAINFALL ENERGY IN EASTERN AUSTRALIA: INTENSITY-KINETIC ENERGY RELATIONSHIPS FOR CANBERRA, A.C.T.,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
P. I. Kinnell.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 547-553, 1987. 2 fig, 9 ref.

Descriptors: *Rainfall, *Kinetic energy, *Rainfall intensity, Kinetics, Precipitation intensity, Australia, Erosion, Comparison studies, Canberra, Gunnedah, Mathematical equations, Rainfall distrometers, Air turbulence.

Much of the energy causing erosion under rainy conditions is derived from the expenditure of kinetic energy of raindrops as they hit soil and surface-water layers. Rainfall kinetic energy values measured with a Joss-Waldvogel rainfall distrometer near Canberra are reported and compared with other data obtained in Australia using the same measurement technique. No substantial difference was observed in the relationships between rainfall intensity and kinetic energy at two inland sites, Canberra and Gunnedah, located 480 km apart. Mathematical equations are presented that allow reasonable estimation of the amount of rainfall energy available to generate erosion in much of the inland area of south-eastern Australia. The data provided support the theory that the inherent instability of large raindrops results in relatively few large raindrops surviving the high degree of air turbulence that is associated with high rainfall intensities. (Wood-PTT)
W88-07705

RAINFALL CONDITIONS AND EROSIVITY IN THE NJALA AREA OF SIERRA LEONE,
Department of Environmental Studies and Geography, Njala University College, University of Sierra Leone, Private Mail Bag, Freetown, Sierra Leone.
For primary bibliographic entry see Field 2J.
W88-07710

STATISTICAL STUDY OF THE NORTH DAKOTA CLOUD MODIFICATION PROJECT,
Oklahoma Univ., Norman. Oklahoma Climatological Survey.
For primary bibliographic entry see Field 3B.
W88-07741

MESOSCALE ACID DEPOSITION MODEL: PRELIMINARY APPLICATIONS AND A GUIDE FOR USER INTERFACE,
Iowa Univ., Iowa City. Dept. of Chemical and Materials Engineering.
For primary bibliographic entry see Field 5B.
W88-07757

EFFECTS OF RAINFALL ON THE SEASONAL THERMOCLINE,
Naval Postgraduate School, Monterey, CA.
G. H. Garzon.
Available from the National Technical Information Service, Springfield, VA. 22161, as AD-A184-432. Price codes: A04 in paper copy, A01 in microfiche. Thesis Submitted for Partial Fulfillment of the Requirements for the Degree of Master of Science in Meteorology and Oceanography, June 1987. 69 p, 24 fig, 1 tab, 14 ref.

Descriptors: *Rainfall, *Thermocline, *Oceanography, *Salinity, *Thermal stratification, Mixing, Temperature, Precipitation, Marine environment, Simulation analysis, Model studies, Seasonal variation.

An oceanic planetary boundary layer model was used to determine the effects of fresh water flux on the seasonal pycnocline and mixed layer at Ocean Station 'P' (50 N, 145 W). First sensitivity of the model was tested by constant forcing with a range of values of precipitation minus evaporation. Then realistic forcing with daily average evaporation, monthly average precipitation values, observed winds and heat fluxes were applied to the model for a simulation of the year 1967. The sensitivity study revealed that precipitation and evaporation have a significant impact on the seasonal evolution of mixed layer depth and temperature, even though the surface heat flux is not changed. The use of realistic forcing indicates the importance of having realistic initial salinity profiles in such models. This is especially true in the autumn and winter seasons when rainfall reduces seasonal mixed layer deepening by as much as 25 meters, representing a 20% change. For the simulation of the year 1967, the model predicted values of salinity very closely follow climatology for the first half of the year. During the late summer and fall, predicted salinity is greater than suggested by the climatology and may be due to unrealistically steady values of precipitation. (Author's abstract)
W88-07778

SOIL LOSS ESTIMATION: A MODELLING TECHNIQUE,
Institute of Agricultural Engineering, Harare (Zimbabwe).
For primary bibliographic entry see Field 2J.
W88-07897

METHOD FOR REMOTE SENSING OF PRECIPITABLE WATER VAPOR AND LIQUID IN THE ATMOSPHERE USING A 22-GHZ RADIOMETER,
Aerospace Corp., El Segundo, CA. Lab. Operations.
For primary bibliographic entry see Field 7B.
W88-07959

2C. Snow, Ice, and Frost

DISTRIBUTION, STRUCTURE, AND COMPOSITION OF FRESHWATER ICE DEPOSITS IN BOLIVIAN SALT LAKES,
San Diego State Univ., CA. Dept. of Biology.
S. H. Hurlbert, and C. C. Y. Chang.
Hydrobiologia HYDRB8, Vol. 158, p 271-299, January 1988. 6 fig, 8 tab, 36 ref.

Descriptors: *Salinity, *Salt lakes, *Ice deposits, *Bolivia, *Limnology, Playas, Sediments, Isotope studies, Rainfall, Spatial distribution, Lakes, Bolivia.

Freshwater ice deposits are described from seven, high elevation (4117-4730 m), shallow (mean depth <30 cm), saline (10-103 g/L) lakes in the southwestern corner of Bolivia. The ice deposits range to several hundred meters in length and to 7 m in height above the lake or playa surface. They are located near the lake or salar margins; some are completely surrounded by water, others by playa deposits or salt crusts. Upper surfaces and sides of the ice deposits usually are covered by 20-40 cm of white to light brown, dry sedimentary materials. Calcite is the dominant crystalline mineral in these, and amorphous materials such as diatom frustules and volcanic glass are also often abundant. Beneath the dry overburden the ice occurs primarily as horizontal lenses 1-1000 mm thick, irregularly alternating with strata of frozen sedimentary materials. Ice represents from 10 to 87% of the volume of the deposits and yields freshwater (TFR <3 g/L) when melted. Oxygen isotope ratios for ice are similar to those for regional precipitation and shoreline seeps but much lower than those for the lakewaters. Geothermal flux is high in the region as evidenced by numerous hot springs and deep (3.0-3.5 m) sediment temperatures of 5-10 deg C. This flux is one cause of the present gradual wasting away of these deposits. Mean annual air temperatures for the different lakes probably are all in the range of -2 to 4 deg C, and mean midwinter temperatures about 5 deg C lower. These deposits apparently formed during colder climatic conditions by the freezing of low salinity porewaters and the building up of segregation ice lenses. (Author's abstract)
W88-06996

EVALUATION OF A SNOWMELT MODEL IN A BOREAL FOREST, (EVALUATION D'UN MODELE DE FONTE NIVALE EN FORET BOREALE),
Laboratoire d'Hydrologie Forestiere, Departement des Sciences Forestieres, Faculte de Foresterie et de Geodesie, Universite Laval, 0830 Pavillon Vachon, sainte-Foy, Que. G1K 7P4 (Canada).
J. Roberge, J. Stein, and A. Plamondon.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 161-179, January 15, 1988. 7 fig, 5 tab, 21 ref.

Descriptors: *Snowmelt, *Snowpack, *Forest hydrology, *Model studies, Simulation, Snow, Discharge hydrographs, Streamflow, Temperature effects, Canada, Fir trees.

SNOW-17, a temperature-index snowmelt model was tested on an experimental plot in a boreal fir forest, 80 km north of Quebec city. Simulations were produced with a one hour time step for the melt seasons of 1981 to 1985. The calibration was done with 1982 and 1984 data. The outputs considered were: snowpack water equivalent, cumulated outflow, daily outflow, hourly outflow and some characteristics of daily hydrographs. The results were verified with field data and compared with those of a degree-day model previously calibrated on the same site. The calibration modified the a-priori attributed values of the model parameters very little. Some parameters appeared to be sensitive to alteration of the forest cover which occurred during the test period. In general SNOW-17 gave an accurate and precise estimation of the considered variables. Some weak points are identified. The results from SNOW-17 stayed consistently better than those provided by the degree-day model. SNOW-17 seems to be an efficient snowmelt model especially adequate for the boreal

forest environment of eastern Canada. (Author's abstract)
W88-07304

PILE LOAD TESTS IN SALINE PERMAFROST AT CLYDE RIVER, NORTHWEST TERRITORIES,
Hardy, BBT Limited, 221 - 18th St. S.E., Calgary, Alta., Canada T2E 6J5.
For primary bibliographic entry see Field 8G.
W88-07425

ESTIMATION OF VOLUME OF SNOWMELT FROM TEMPERATURE OF SNOW LINE AND RESIDUAL SNOW AMOUNT,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-07523

MICRO-METEOROLOGICAL CONDITIONS FOR SNOW MELT,
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
M. Kuhn.
Journal of Glaciology JOGLAO, Vol. 33, No. 113, p 24-26, 1987. 1 fig, 6 ref, append.

Descriptors: *Snowmelt, *Ice, *Melting, *Energy transfer, *Glaciology, Meteorology, Micrometeorology, Air temperature, Temperature, Albedo, Radiation, Solar radiation, Humidity.

Conditions at the exact onset and exact end of snow or ice melting were investigated, using air temperature, humidity and radiation (the sum of global and reflected short-wave plus downward long-wave radiation). For the turbulent exchange in the boundary layer, examples were computed with a transfer coefficient of 18.5 W per sq m per K, which corresponded to the average over the ablation period on an Alpine glacier. Ways to estimate the transfer coefficient for various degrees of stability were presented in the appendix. Calculations indicated that snow may melt at air temperatures as low as -10 C and may stay frozen at temperatures as high as +10 C. (Cassar-PTT)
W88-07535

AIRBORNE RIVER-ICE THICKNESS PROFILING WITH HELICOPTER-BORNE UHF SHORT-PULSE RADAR,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. A. Arcone, and A. J. Delaney.
Journal of Glaciology JOGLAO, Vol. 33, No. 115, p 330-340, 1987. 14 fig, 2 tab, 14 ref. U.S. Army Cold Regions Research and Engineering Laboratory, River Ice Management Program of Civil Works Project CWIS 32284.

Descriptors: *Ice thickness, *Data acquisition, *River ice, *Aircraft, *Remote sensing, *Radar, Tanana River, Yukon River, Ice cover, Frazil ice, Microwaves, Alaska.

The ice-thickness profiling performance of a helicopter-mounted short-pulse radar operating at approximate center frequencies of 600 and 900 MHz was assessed. The antenna packages were mounted 1.2 m off the skid of a small helicopter whose speed and altitude were varied from about 1.8 to 9 m/s and 3 to 12 m. Clutter from the helicopter offered minimal interference with the ice data. Data were acquired in Alaska over lakes (as a proving exercise) and two rivers, whose conditions varied from open water to over 1.5 m of solid ice with numerous frazil-ice formations. The most readily interpretable data were acquired when the ice or snow surface was smooth. Detailed surface investigations on the Tanana River revealed good correlations of echo delay with solid ice depth, but an insensitivity to frazil-ice depth due to its high water content. On the Yukon River, coinciding temporally coherent surface and bottom reflections were associated with solid ice and smooth surfaces. All cases of incoherent surface returns (scatter) occurred over ice rubble. Rough-surface scattering was always followed by the appearance of bottom scattering but, in many cases, including a hanging-wall formation of solid frazil ice, bottom scattering occurred beneath coherent, smooth-surface reflections. Areas of incoherent bottom scattering investigated by drilling revealed highly variable ice conditions, including frazil ice. The minimum ice thickness that could be resolved from the raw data was about 0.2 m with the 600 MHz antenna and < 0.15 m with the 900 MHz antenna. (Author's abstract)
W88-07536

ACID PULSES FROM SNOWMELT AT ACIDIC CONE POND, NEW HAMPSHIRE,
IEP, Inc., Northborough, MA.
For primary bibliographic entry see Field 5C.
W88-07594

CHEMICAL COMPOSITION OF HOARFROST, RIME AND SNOW DURING A WINTER INVERSION IN UTAH, U.S.A.,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W88-07605

COMPOSITION OF ACIDIC MELTWATERS DURING SNOWMELT IN THE SCOTTISH HIGHLANDS,
Dept. of Oceanography, The Univ., Southampton S09 5NH, U.K.
For primary bibliographic entry see Field 5B.
W88-07610

SYNOPTIC CLIMATOLOGY OF ABLATION ON A NEW ZEALAND GLACIER,
Environmental Science, Univ. of Auckland, Auckland, New Zealand.
J. E. Hay, and B. B. Fitzharris.
Journal of Climatology JOUCD2, Vol. 8, No. 2, p 201-215, March-April 1988. 6 fig, 5 tab, 28 ref.

Descriptors: *Climatology, *Ablation, *Glaciers, *New Zealand, *Melting, *Energy, Radiation, Convection, Weather patterns, Energy, Maritime climate.

Local scale ablation and energy budget measurements are reported for the Ivory glacier in the Southern Alps of New Zealand over 53 days during two consecutive summer periods. Ablation averaged 38 mm/day, but varied from less than 10 mm/day to over 70 mm/day. Radiation supplied 52% of the energy for glacier melt, with the convective fluxes contributing most of the remainder. The results are related to large scale synoptic weather patterns over the southwest Pacific region. Different synoptic situations generate distinctive energy budgets, with radiation important during southerly circulation patterns and the convective fluxes relatively more important with northerly circulation patterns. These findings are discussed in the context of the retreat of New Zealand glaciers this century and possible circulation changes. The larger scale atmospheric circulation also controlled the relative contributions to melt of the terms of the energy budget. Net radiation dominated the melt budget during southerly flows, but the convective fluxes and associated nocturnal melt became more important with airflows from the north-west to convective fluxes and associated nocturnal melt became more important with airflows from the north-west to north-east. This sensitivity of ablation rate and energy budget is a direct consequence of the glacier's location on the flanks of a major alpine chain in a maritime setting. The long term behavior of the Ivory glacier appears to be sensitive to the frequency of synoptic weather types that accompany circulation changes in the south-west Pacific region, especially the relative strengths of the westerlies and of blocking anticyclones. (Alexander-PTT)
W88-07632

EFFECTS OF SNOW AND ICE ON THE ANNUAL CYCLES OF HEAT AND LIGHT IN SAQVAQJUAC LAKES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W88-07641

SUPPLEMENTAL NOTE TO THE COMBINED ROLE OF KINEMATICS, THERMODYNAMICS AND CLOUD PHYSICS ASSOCIATED WITH HEAVY SNOWFALL EPISODES,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
A. H. Auer.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 2, p 299-301, April, 1987. 1 fig, 3 tab, 1 ref.

Descriptors: *Thermodynamics, *Cloud physics, *Snow, *Climatology, *Meteorology, *Condensation, Precipitation, Atmospheric physics, Weather, Temperature, Air temperature, Ice.

A mini-climatological study was conducted of upper air thermal conditions occurring in the ascending air of synoptic circulations which yielded heavy snowfall amounts. Results strongly support the premise of Auer and White (1982), who claimed that regions of maximum rate of condensate that occur near the level of nondivergence at temperature regimes near -15 C must be suspect for producing heavy snowfall episodes. Heavy snowfalls are expected to occur in regions where the level of nondivergence (maximum vertical velocities for saturated ascent) is coincident in elevation with the maximum growth rate of dendritic ice crystals. It is concluded that, for heavy snowfall, saturated ascent through the level of nondivergence must be confined to a 600 mb temperature between -13 C and -17 C. (Doria-PTT)
W88-07683

EFFECTS OF SURFACE ROUGHNESS AND POROSITY ON THE RIMING OF SNOWFLAKES,
Meteorological Research Inst., Yatabe (Japan).
For primary bibliographic entry see Field 2B.
W88-07685

VARIATIONS IN THE ONSET OF THE SUMMER MONSOON OVER INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
For primary bibliographic entry see Field 2B.
W88-07687

BREAKUP OF SMALL RIVERS IN THE SUBARCTIC,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
M.-K. Woo, and R. Heron.
Canadian Journal of Earth Sciences CJESAP, Vol. 24, No. 4, p 784-795, April 1987. 12 fig, 27 ref.

Descriptors: *Subarctic zone, *Ice, *Ice jams, *River flow, *Ice breakup, *Wetlands, Snowmelt, Small river breakup, James Bay, Hudson Bay, Snow, Rivers, Canada, Seasonal variation.

At the end of the winter, the channels of small, subarctic rivers in the coastal James Bay Lowland are filled with snow, river ice, and icing. The major processes associated with the breakup of these rivers include the melting of the snow cover and the resultant generation of meltwater, the impoundment of meltwater runoff by snow dams, the disintegration and ablation of the river ice cover, the formation and dissipation of ice jams, and an exchange of overland and channeled flow between the rivers and their adjacent wetlands. A generalization of the breakup sequences allows a qualitative prediction of the events for specific segments of the channel. Findings of this study are applicable to the many small, subarctic rivers that fringe the James Bay and Hudson Bay Coasts. (Author's abstract)
W88-07935

THERMAL REGIME OF PEATLANDS IN SUBARCTIC EASTERN CANADA,

McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W88-07936

SEDIMENTS OF ICE-DAMMED, SELF-DRAINING APE LAKE, BRITISH COLUMBIA,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W88-07937

ALBEDO MODEL FOR SHALLOW PRAIRIE SNOW COVERS,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
D. M. Gray, and P. G. Landine.
Canadian Journal of Earth Sciences CJESAP, Vol. 24, No. 9, p 1760-1768, September 1987. 7 fig, 3 tab, 17 ref.

Descriptors: *Snow cover, *Prairies, *Mathematical models, *Simulation, *Albedo, *Solar radiation, *Snowmelt, *Ablation, Algorithm, Canada, Energy, Grasslands.

A model for simulating the decrease in albedo of melting prairie snow covers is presented. Its application for calculating net radiation and establishing the time of melt is demonstrated. It is expected the routine will find use in operational systems for synthesizing and forecasting streamflow runoff from snowmelt. The model is based on point and aerial observations of incoming and reflected global radiation taken from February 1 to the end of ablation of the seasonal snow cover, over a 14-year period, in the open grassland area of western Canada. For complete snow covers not subject to frequent melt events, the albedo-depletion curve is approximated by three line segments of constant slope describing the periods of (1) premelt - the months preceding the occurrence of 'active' melt; (2) melt - the period of rapid ablation that leads to the disappearance of the seasonal snow cover; and (3) postmelt - the days following melt. An algorithm of the model is developed and procedures for defining the start of melt and albedo depletion from daily inputs of net radiation, maximum air temperature, and snow-cover and snowfall depths are described. Data are presented that demonstrate close agreement between simulated and measured albedo-depletion curves for 'deep' (depth $>$ 25 cm) and 'shallow' (depth $<$ or $=$ 25 cm) snow covers. The mean difference between simulated and measured albedo on 74 days of melt over 7 years of record was calculated to be -0.0007 with a standard deviation of 0.17. The model is applied for calculating daily net radiation during the melt period. This analysis makes use of an empirical relationship to estimate net radiation from the clear-sky insolation, sunshine hours, and simulated albedo. Comparison of the differences between simulated and measured values for 62 days of melt gave a mean and standard deviation of 0.49 and 2.05 MJ/(sq m x d), respectively. (Author's abstract)
W88-07938

SEDIMENTATION IN ICE-DAMMED HAZARD LAKE, YUKON,
Alberta Univ., Edmonton.
For primary bibliographic entry see Field 2J.
W88-07939

UPFREEZING PROCESS: EXPERIMENTS WITH A SINGLE CLAST,
Washington Univ., Seattle. Quaternary Research Center.
S. P. Anderson.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 4, p 609-621, April 1988. 18 fig, 5 tab, 42 ref. NSF Grant DPP-8303630.

Descriptors: *Freezing, *Thaw, *Upfreezing, *Soil water, *Frost heaving, Physical properties, Silt, Frost, Temperature effects.

Laboratory experiments yielding detailed temperature and displacement measurements of a 90-mm clast and of surrounding frost-susceptible silt during repeated freeze/thaw cycling clarify the physics of the upfreezing process. Upward motion of the clast initiates when the freezing isotherm is a significant fraction (.3-.5) of the way down the clast is then strong enough to balance both the clast weight and the cohesive bond between the unfrozen soil and the clast. A cavity opens below the clast during the freeze. Its partial infilling prevents the clast from settling to its original position at the end of the thaw cycle. The magnitude of net clast displacement after a complete freeze/thaw cycle depends on (1) the frost heave strain in the soil, (2) the effective dimensions of the clast that contact unfrozen soil at the onset of clast heave, and (3) the fraction of the clast's freezing-cycle displacement retained at the end of the thaw cycle. The temperature in the clast remains very close to that of the surrounding soil, contrary to common assumption; however, the 0 C isotherm does advance more rapidly through the clast than through the soil. (Author's abstract)
W88-07954

2D. Evaporation and Transpiration

RELATIONSHIP BETWEEN WATER USE EFFICIENCY AND CUTICULAR WAX DEPOSITION IN WARM SEASON FORAGE CROPS GROWN UNDER WATER DEFICIT CONDITIONS,
Faculty of Applied Biological Science, Hiroshima Univ., Fukuyama, Hiroshima, 720 Japan.
For primary bibliographic entry see Field 3F.
W88-06826

ESTIMATION OF SURFACE WATER EVAPORATION RATES BY CONTINUOUS RADIOGAUGING,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
N. N. Barthakur, and J. S. Tomar.
Communications in Soil Science and Plant Analysis CSOSA2, Vol. 18, No. 9, p 1117-1130, 1987. 2 fig, 2 tab, 15 ref.

Descriptors: *Evaporimeters, *Gaging, *Evaporation rate, *Radioactivity techniques, *Soil surfaces, Radioisotopes, Radiometry, Mathematical models, Fluid drops, Drying, Beta-rays, Field tests.

A beta-ray gauge system was used to estimate the water evaporation rates from artificial and soil surfaces. The system used in these experiments consists of a linear arrangement of a collimated point source of thallium-204, a wet surface or a wet soil sample as an absorber, and a Geiger-Mueller detector. The predictions of a mathematical model based on cylindrical water drops agreed fairly well with the original observations of such water drops on soybean leaves. Because the model assumes that the diameter of the drop remains constant throughout the drying process, the determination of the rate of evaporation of water reduces to one-dimensional thickness measurements with time. The drying time of a surface was found to be highly dependent upon whether it was wetted with drops or with a uniform layer. Gravimetrically determined evaporation rates from soil surfaces were highly correlated with those obtained by the beta-ray gauge under various environmental conditions. Field application of the beta-ray gauge in measuring water evaporation rates is suggested on the basis of its performance in the laboratory. (Author's abstract)
W88-07183

SEMI-EMPIRICAL MODEL FOR CALCULATING EVAPORATION AND TRANSPIRATION FROM WETLAND RICE,
Division of Agricultural and Food Engineering, Asian Institute of Technology, P.O. Box 2754, Bangkok 10501, Thailand.
J. R. Jensen, and M. M. Rahman.
Agricultural and Forest Meteorology, Vol. 41, No. 3/4, p 289-306, December 1987. 8 fig, 2 tab, 31 ref.

Descriptors: *Mathematical models, *Evapotranspiration, *Evaporation, *Transpiration, *Wetlands, *Rice, Wind, Leaves, Net radiation, Specific conductivity, Lysimeters, Water stress.

A model for evapotranspiration (ET) from wetland rice fields was formulated, using the combination method and the wind functions of Penman and Stigter to calculate evaporation and transpiration, respectively. Partitioning of total evaporation among the two surfaces, water and crop, was accomplished by assuming an exponential extinction of net radiation with leaf area index, and by introducing into the aerodynamic terms empirical aerodynamic efficiency functions, representing the ratio of aerodynamic conductance in the presence of the other surface to conductance when the surface is present alone. These two functions were calibrated and the model tested on a dry season lysimeter field investigation, including measurement of evaporation, transpiration, and evapotranspiration. Although the model was not tested on a truly independent dataset, it was concluded that when accumulating daily estimates over 5-day periods, the model performed well with an ET estimation error of 6%. The aerodynamic efficiency functions remained constant in the period 25-84 days after transplanting, at values of 0.58 (water) and 0.75 (crop), and it was concluded that aerodynamically, the rice crop reached full cover at a leaf area index of about 1.5, but energetically at a leaf area index of 3. During the same period, evaporation was 1.4 mm/day and transpiration 6.1 mm/day, with a peak during flowering of 9.0 mm/day. For the entire crop season, it was estimated that evaporation contributed about 1/3 of ET. The importance of surface-water evaporation, when analyzing water stress situations and for formulating a soil-plant-atmosphere concept applicable to wetland rice, is pointed out. (Author's abstract)
W88-07185

INFLUENCE OF INSTALLATION PRACTICES ON EVAPORATION FROM SYMON'S TANK AND AMERICAN CLASS A-PAN EVAPORIMETERS,
Hydrological Research Institute, Department of Water Affairs, Private Bag X313, Pretoria, 0001, Republic of South Africa.
For primary bibliographic entry see Field 7A.
W88-07186

SYNOPTIC EVAPOTRANSPIRATION MODEL APPLIED TO TWO NORTHERN FORESTS OF DIFFERENT DENSITY,
B. Bringfelt, and A. Lindroth.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 185-201, 30 November 1987. 6 fig, 4 tab, 32 ref.

Descriptors: *Evapotranspiration, *Synoptic analysis, *Mathematical models, *Forests, *Forest hydrology, *Transpiration, *Interception, Interception loss, Energy, Throughfall, Precipitation, Estimating equations, Bowen ratio, Penman equation, Rutter's equation, Leaves, Stomatal transpiration.

The aim of this study was to develop and test a model at one site and apply it to another site where validation data such as transpiration and interception were available. The model was based on the Penman combination equation for transpiration and on Rutter's equation for interception evaporation. The transpiration was estimated from energy balance/Bowen ratio measurements at both sites and the interception evaporation was estimated from measurements of throughfall and gross precipitation. Total evapotranspiration calculated by the model was within 10% of the evapotranspiration of the application site when using parameters estimated from the test site data. However, this agreement was apparent in the sense that the model underestimated the transpiration by about 20% and overestimated the interception evaporation by about 60%. An attempt was made to derive an independent parameter set on the basis of the test site values. The parameter determining the magnitude of the surface resistance was scaled with respect to the difference in leaf area index between the forests and with respect to the relative differences in stomatal resistance between the different species. Using this modified parameter set resulted in a 50% underestimation of the transpira-

tion. It is concluded that factors other than forest density and species were responsible for the scaling of the surface resistance between different forests. (Author's abstract)
W88-07201

ESTIMATION OF AVERAGE AREAL EVAPOTRANSPIRATION: PROPOSAL TO MODIFY MORTON'S MODEL BASED ON THE COMPLEMENTARY CHARACTER OF ACTUAL AND POTENTIAL EVAPOTRANSPIRATION,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
G. Kovacs.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 227-240, 30 November 1987. 4 fig, 29 ref.

Descriptors: *Evapotranspiration, *Estimating equations, *Mathematical models, *Morton model, *Evapotranspiration potential, Soil-water-plant relationships, Radiation, Ventilation, Hydrology.

Actual areal evapotranspiration has paramount importance in hydrology, but an estimation method easily applicable in practice and providing acceptable accuracy is still missing. The concept based on the complementary character of actual and potential evapotranspiration provides a promising method of estimating the areal evapotranspiration average without requiring the detailed investigation of plant-soil-water systems. The first model based on this concept was proposed by Morton. Morton's model can be simplified by introducing a slight modification to the starting hypothesis; an important characteristic of the model derived in this way is the different interpretation of the space-scale used for calculation of the radiation and ventilation terms. The purpose of this paper is to promote the better understanding and the wide application of this method by analyzing some open questions of the complementarity theory, such as: Are the assumptions used in simplifying the original model acceptable. What is the size of the area that can be characterized from the data of a single meterological station. What is the best method (simple enough yet providing acceptable accuracy) for the estimation of the radiation term. (Shidler-PTT)
W88-07203

MOVEMENT OF ISOTOPES OF WATER DURING EVAPORATION FROM A BARE SOIL SURFACE,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
G. R. Walker, M. W. Hughes, G. B. Allison, and C. J. Barnes.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 181-197, February 15, 1988. 5 fig, 10 ref, 3 append.

Descriptors: *Stable isotopes, *Evaporation, *Air-earth interface, *Isotope studies, *Evaporation, *Physical properties, Evaporation rate, Soil water, Mathematical studies.

Stable isotopes of water (H2, O18) at natural levels were used to measure steady-state evaporation from soil surfaces in situations where other techniques would fail. In an effort to generalize the technique, the movement of isotopes during non-steady evaporation, especially during second-stage evaporation were investigated. Equations describing the isotope profiles were developed; it was found that the isotope concentration is a function of the Bolzmann variable (depth time to the - 1/2 power). The equations were then solved under the assumption that the evaporation front is narrow. Seven packed sand columns were allowed to evaporate under controlled conditions and then sectioned for analysis of water content and isotopic composition. The results agree generally with the theory but there are difficulties with using isotopes to estimate cumulative evaporation. (Author's abstract)
W88-07305

TRANSPIRATION OF AN OAK FOREST AS PREDICTED FROM POROMETER AND WEATHER DATA,
Department of Physical Geography and Soil Science, State University of Groningen, Melkwey 1, 9718 EP Groningen (The Netherlands).
A. J. Dolman.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 225-234, February 15, 1988. 3 fig, 2 tab, 21 ref.

Descriptors: *Transpiration, *Forests, *Lysimeters, *Stomatal transpiration, Model studies, Evapotranspiration, Soil moisture, Aeration zone, Porometry, Mathematical equations, Oak trees.

Transpiration of an oak forest located on one of the Castricum lysimeters was predicted from the Penman-Monteith equation and a model of canopy conductance based on porometer measurements of stomatal conductance. An upper limit to daily transpiration of 2.1 mm was introduced to regulate daily water loss. The model predicts transpiration to within 10% of observed losses on a seasonal basis. From measurements of soil moisture content and groundwater depth it appeared that the trees first depleted the unsaturated zone and only when this moisture reservoir was emptied, started to use water from the saturated zone. The introduction of an upper limit to daily transpiration improved the model drastically. The trees on the lysimeter were very small and thin. It may be that the water storage in stems, roots, and foliage is not sufficient to maintain high transpiration rates. After sustaining 2.1 mm of transpiration, a level of leaf water potential is reached at which stomatal closure occurs. (Friedmann-PTT)
W88-07308

COMPARISON OF TWO RECENT MODELS FOR ESTIMATING ACTUAL EVAPOTRANSPIRATION USING ONLY REGULARLY RECORDED DATA,
Department of Environmental Resources, Cook College, Rutgers University, New Brunswick, NJ 08903 (U.S.A.).
M. F. Ali, and J. A. Mawdsley.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 257-276, September 15, 1987. 10 fig, 3 tab, 22 ref.

Descriptors: *Evapotranspiration, *Mathematical models, *Meteorological data, *Data collection, United Kingdom, Mathematical studies, Model studies.

An advection-aridity model for estimating actual evapotranspiration is tested with over 700 days of lysimeter evapotranspiration and meteorological data from barley, turf and rye-grass from three sites in the U.K. The performance of the model was also compared with the API model. It was observed that the advection-aridity model overestimates nonpotential evapotranspiration and tends to underestimate potential evapotranspiration, but when tested with potential and nonpotential data together, the tendencies appear to cancel each other. On a daily basis the performance level of this model is found to be of the same order as the API model: correlation coefficients were obtained between the model estimates and lysimeter data of 0.62 and 0.68 respectively. For periods greater than one day, generally the performance of the models are improved. (Author's abstract)
W88-07563

MICROCLIMATE AND ACTUAL EVAPOTRANSPIRATION IN A HUMID COASTAL-PLAIN ENVIRONMENT,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5E.
W88-07565

LAND-USE CHANGES AND WATER RESOURCES IN A KARSTIC MEDITERRANEAN REGION (EVOLUTION DE L'OCCUPATION DES TERRES ET RESSOURCES EN EAU EN REGION MEDITERRANEENNE KARSTIQUE),
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
For primary bibliographic entry see Field 4C.
W88-07567

CHARACTERIZING WATER USE BY IRRIGATED WHEAT AT GRIFFITH, NEW SOUTH WALES,
Centre for Irrigation and Freshwater Research, Commonwealth Scientific and Industrial Research Organization, Griffith, N.S.W. 2680.
For primary bibliographic entry see Field 3F.
W88-07702

2E. Streamflow and Runoff

FISH COMMUNITY STRUCTURE IN RELATION TO ACIDITY IN THREE NOVA SCOTIA RIVERS,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 5C.
W88-06821

DIEL PERIODICITY IN DENSITY OF EPHEMEROPTERA NYMPHS ON STREAM SUBSTRATA AND THE RELATIONSHIP WITH DRIFT AND SELECTED ABIOTIC FACTORS,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-06822

OCCURRENCE OF GLOCHIDIA IN STREAM DRIFT AND ON FISHES OF THE UPPER NORTH FORK HOLSTON RIVER, VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 2H.
W88-06836

DROUGHT-RELATED CHANGES OF GEOMORPHOLOGIC PROCESSES IN CENTRAL MALI,
Smithsonian Institution, Washington, DC. Center for Earth and Planetary Studies.
P. A. Jacobberger.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 3, p 351-361, March 1988. 11 fig, 2 tab, 42 ref. NASA Contract NAS5-28774.

Descriptors: *Drought, *Geomorphology, *Mali, *Arid lands, *Deserts, *Topographic mapping, *Satellite technology, *Aerial photography, *Stream erosion, Albedo, Aeolian deposits, African Sahel.

Geomorphologic evidence exists for repetitive drought conditions in the African Sahel; within this framework of broad climatic changes through time, the 1968-1985 drought episodes are not abnormal. The impact of recent drought on the economies and environments of Sahelian nations has been substantial, however, and the recovery capabilities of severely damaged lands are not well known. Study of the geomorphology and surface processes across a portion of Mali provides some constraints on the responses of desert fringe fluvial systems to changing environmental conditions. Multitemporal orbital image data were used in combination with field investigation to map drought-affected soils, and to document changes to both fluvial and aeolian processes across the region of study. A combination of statistical methods yields consistent evidence of net albedo increases associated with particular landforms and surface processes over a nine-year interval. Although aeolian processes are a significant transport mechanism for removal and redistribution of soil materials, both orbital data and field study indicate that fluvial erosion is responsible for much of the primary topsoil loss and landform modification in this portion of the Sahel. (Author's abstract)
W88-06841

PREDICTION OF TIDAL SURGE IN LOWER CHESAPEAKE BAY,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W88-06853

FRESHWATER PULSE - A NUMERICAL MODEL WITH APPLICATION TO THE ST. LAWRENCE ESTUARY,
Physical and Chemical Sciences Branch, Department of Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, B2Y 4A2.
For primary bibliographic entry see Field 2L.
W88-06867

NITRATE ENHANCEMENT OF NITRIFICATION DEPTH IN SEDIMENT/WATER MICROCOSMS,
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 5B.
W88-06886

FACTORS CONTROLLING PRIMARY PRODUCTION IN TWO DIVERTED RIVERS WITH A LARGE FLOW REDUCTION (FACTEURS CONTROLANT LA PRODUCTION PRIMAIRE DANS DEUX RIVIERES SOUMISES A UNE FORTE REDUCTION DE DEBIT),
Department of Biological Sciences, University of Quebec at Montreal, C.P. 8888, Succ. A, Montreal, Quebec.
For primary bibliographic entry see Field 6G.
W88-06895

DISTRIBUTION OF BENTHIC INVERTEBRATES IN ACID, BROWN WATER STREAMS IN THE SOUTH ISLAND OF NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-06901

DISSOLVED ORGANIC CARBON IN STREAMS AND GROUNDWATER,
Waterloo Univ. (Ontario). Dept. of Biology.
J. E. Rutherford, and H. B. N. Hynes.
Hydrobiologia HYDRB8, Vol. 154, p 33-48, November 16, 1987.

Descriptors: *Streams, *Groundwater, *Organic carbon, *Water quality, Ontario, Diurnal variation, Salem Creek, Canagagigue Creek, Saugeen River, Ontario, Agricultural watersheds.

Minipiezometers installed at different vertical levels within the streambed (20-140 cm) were used to study temporal and spatial variation in the dissolved organic carbon (DOC) content of stream water and groundwater in three southern Ontario streams. Groundwater, as represented by the streambed samples, contained considerable quantities of DOC, but variation between replicate samples was high. Diel fluctuations in DOC content of stream water were consistent with daytime autochthonous production and night-time uptake by heterotrophs. Water from the streambed neither consistently diluted nor enhanced stream water levels of DOC. At some stations DOC variation with depth, including stream water, seemed to be largely random. At other stations, DOC concentrations from the deepest piezometers were consistently higher than concentrations at intermediate depths, suggesting a loss of DOC from deeper waters to overlying sediments. However, at these stations DOC concentrations were highest at 20 cm and at the surface. Interflow delivery of DOC to the shallow layers of the streambed may be a significant source of carbon for a stream ecosystem, especially in agricultural areas. Late summer diel fluctuations at one station may be related to changing patterns of intermixing of stream and groundwater in the upper layers of the streambed as governed by velocity heads, convective currents, and evapotranspiration. (Author's abstract)
W88-06902

PARTICULATE ORGANIC MATTER IN A MOUNTAIN STREAM IN THE SOUTH-WESTERN CAPE, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
J. M. King, J. A. Day, B. R. Davies, and M.-P Henshall-Howard.
Hydrobiologia HYDRB8, Vol. 154, p 165-187, November 16, 1987. 7 fig, 10 tab, 54 ref.

Descriptors: *Streams, *Data collections, *Organic matter, *Mountain streams, *Leaves, Litter, Riparian vegetation, Detritus, Seasonal variation.

Organic matter was studied in Langrivier, a second-order perennial mountain stream in the southwest Cape, South Africa, from April 1983 to January 1986. This catchment has a mediterranean climate with winter rainfall. The vegetation is sclerophyllous, evergreen, and shrubby. Leaf fall in this community is seasonal, occurring in spring (November) as stream discharge decreases. Inputs of allochthonous detritus to the stream were 434-500 g/sq m/yr; calorific inputs, 9,548-10,032 KJ/sq m/yr. Benthic organic matter (BOM) was retained on the streambed during summer and early autumn (maximum 224 g/sq m). Early winter rains in May scoured the stream almost clean of benthic detritus (winter minimum 8 g/sq m). Coarse BOM and fine BOM constituted 46-64% of BOM standing stock; ultra-fine BOM, 16-33%, and leaf packs, 13-24%. The mean annual calorific value of total BOM standing stock was 1709 KJ/sq m. Values of C:N ratios decreased with decrease in BOM particle size (coarse BOM, 27-100; fine BOM 25-27; ultra-fine BOM, 13-19) with no seasonal trends. Although the litter input and calorific value of the input to the Langrivier were similar to those of like streams in other parts of the world, the retained BOM was markedly lower. This was attributed to the fast-flowing, turbulent nature of the stream, which responds rapidly to the very powerful spates. The mean unit stream power was calculated to be 1.37 kg-m/sec in winter and 0.18 kg-m/sec in summer. (Cassar-PTT)
W88-06907

NUISANCE BIOMASS LEVELS OF PERIPHYTIC ALGAE IN STREAMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W88-06917

NITRATE DEPLETION IN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM,
York Univ., Toronto (Ontario). Dept. of Geography.
J. Warwick, and A. R. Hill.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 231-240, January 22, 1988. 3 fig, 3 tab, 40 ref.

Descriptors: *Streams, *Fate of pollutants, *Denitrification, *Nitrates, *Riparian waters, Nitrogen removal, Groundwater movement, Forest hydrology.

Field enrichments with nitrate in two spring-fed drainage lines within the riparian zone of a small woodland stream near Toronto, Ontario, showed an absence of nitrate depletion. Laboratory experiments with riparian substrates overlain with nitrate-enriched solutions revealed a loss of only 5-8% of the nitrate during a 48-hour incubation at 12 C. However, 22-24% of the initial nitrate was depleted between 24 and 48 hours when a second set of substrate cores was incubated at 20 C. Short-term (3-hour) incubations of fresh substrates amended with acetylene were used to estimate in situ denitrification potentials, which varied from 0.05-3.19 microgram N/g/day for organic and sandy sediments. Denitrification potentials were highly correlated with initial nitrate content of substrate samples, implying that low nitrate levels in groundwater and riparian substrates may be an important factor in controlling denitrification rates. The efficiency of nitrate removal in spring-fed drainage lines is also limited by short water residence times of <1 hour within the riparian zone. These data suggest that routes of groundwater movement and substrate characteristics are important in determining nitrate depletion within stream riparian areas. (Author's abstract)
W88-06919

USE OF LANDSAT MULTISPECTRAL SCANNER DATA FOR THE ANALYSIS AND MANAGEMENT OF FLOODING ON THE RIVER SEVERN, ENGLAND,
Department of Geography, University of Leicester, Leicester LE1 7RH, U.K.
For primary bibliographic entry see Field 7B.
W88-06974

EXPERIMENTAL ENRICHMENT OF A COASTAL STREAM IN BRITISH COLUMBIA: EFFECTS OF ORGANIC AND INORGANIC ADDITIONS ON AUTOTROPHIC PERIPHYTON PRODUCTION,
Limnotek Research and Development Inc., 4035 West 14th Avenue, Vancouver, B.C. V6R 2X3.
For primary bibliographic entry see Field 2H.
W88-07097

BASIC HYDROLOGIC STUDIES FOR ASSESSING IMPACTS OF FLOW DIVERSIONS ON RIPARIAN VEGETATION: EXAMPLES FROM STREAMS OF THE EASTERN SIERRA NEVADA, CALIFORNIA, USA,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 6G.
W88-07101

SUSPENDED SEDIMENT LOAD AND MECHANICAL EROSION IN THE SENEGAL BASIN--ESTIMATION OF THE SURFACE RUNOFF CONCENTRATION AND RELATIVE CONTRIBUTIONS OF CHANNEL AND SLOPE EROSION,
Centre de Sedimentologie et de Geochimie de la Surface, Institut de Geologie, Rue Blessig, 67084 Strasbourg Cedex, France.
For primary bibliographic entry see Field 2J.
W88-07108

INDICES OF HYDROLOGICAL DROUGHT IN ISRAEL,
Israel Hydrological Service, P.O. Box 6381, Jerusalem, Israel.
For primary bibliographic entry see Field 2A.
W88-07114

REPRESENTATION OF FLOWS TO PARTIALLY PENETRATING RIVERS FROM LAYERED AND ANISOTROPIC AQUIFERS,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 2F.
W88-07196

ESTIMATING FLOOD PEAKS FROM SMALL RURAL CATCHMENTS IN SWITZERLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
E. Koella.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 203-225, 30 November 1987. 14 fig, 39 ref.

Descriptors: *Flood peak, *Catchment basins, *Estimating equations, *Rational formula, *Rainfall-runoff relationships, *Prediction, *Flood forecasting, Hydrologic systems, Hydrology, Data interpretation, Runoff forecasting, Runoff rates, Storm runoff, Slopes, Traveltime, Saturation deficit, Net rainfall, Rainfall intensity, Rainfall rate, Runoff coefficient, Gaging stations, Switzerland.

Commonly-used methods of estimating floods in Swiss basins are still in a form proposed decades ago. Recent investigations aimed at understanding hydrological systems, together with the availability of more extended data series, lead to the suggestion that currently-used methodologies for estimating design floods are inadequate. Based on fundamental hydrological research and analysis of data, estimation procedures should be updated. This paper gives an outline of a new, physically-based formula for predicting runoff rates caused by storm rainfall. Based on the fundamentals of the Rational Formula, the method proposed to estimate peak flows was established according to the

following assumptions: (1) only hillslopes adjacent to a channel contribute to peak runoff; (2) critical duration of rainfall depends not only on the travel time of water to the outlet of the catchment but also on the time needed to fill up saturation deficits of the defined contributing area; and (3) net rainfall is determined by subtraction of a loss rate and therefore does not depend on rainfall intensity (as it does in the case of introducing a peak runoff coefficient). The proposed method was calibrated against the discharge data from about 170 Swiss gaging stations in rural catchments, each with an area up to 100 sq km. (Author's abstract)
W88-07202

WATER TABLE RISE IN A SEMICONFINED AQUIFER DUE TO SURFACE INFILTRATION AND CANAL RECHARGE,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
S. Mustafa.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 269-276, 30 November 1987. 2 fig, 8 ref.

Descriptors: *Water table fluctuations, *Surface-groundwater relations, *Artificial recharge, *Natural recharge, *Aquifers, *Confined aquifers, *Irrigation effects, *Infiltration, *Rainfall infiltration, *Canal seepage, Mathematical models, Laplace equation, Irrigation canals, Water loss, Water table rise, Unsteady flow, Seepage, Recharge.

In most places where irrigation is practiced, water is conveyed to the fields by canals that are long and often unlined, with attendant problems of high water loss through seepage in transit; the seepage water would gradually lead to water table buildup from an initial position to a new one. In many cases surface infiltration will also contribute to replenishment of the water table; both losses from irrigated fields and rainfall may contribute to such recharge. A general solution to the fluctuation of the water table for unsteady-state flow in a semiconfined and finite aquifer with recharge from canals and surface infiltration is presented. The flow is assumed to be one-dimensional, in a horizontal direction with the recharging canals at different elevations. The Laplace transformation method is employed in the solution. A numerical example is given for a flow situation in a hypothetical finite aquifer bounded by two recharging canals under vertical infiltration giving water-table changes with respect to time. (Author's abstract)
W88-07205

COMBINED HYDROLOGIC SAMPLING CRITERIA FOR RAINFALL AND STREAMFLOW,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W88-07209

RECURSIVE ESTIMATION OF KERNELS OF NONLINEAR RAINFALL-RUNOFF MODELS,
Dames and Moore, 4950 West Kennedy Boulevard, Suite 410, Tampa, FL 33609.
For primary bibliographic entry see Field 2A.
W88-07210

ACID PRECIPITATION AND ITS EFFECTS ON WATER QUALITY OF SMALL RIVER BASINS IN RHODE ISLAND,
Rhode Island Univ., Kingston. Water Resources Center.
For primary bibliographic entry see Field 5C.
W88-07226

STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS,
Department of Civil Engineering, Swiss Federal Institute of Technology, Zuerich, Switzerland.
For primary bibliographic entry see Field 8B.
W88-07245

PERTURBATION SOLUTION OF THE FLOOD-ROUTING PROBLEM,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 215-234, 1987. 13 fig, 8 ref.

Descriptors: *Hydraulics, *Flood routing, *Kinematic wave theory, *Mathematical studies, *Flow characteristics, *Flood hydrographs, Critical flow, Momentum equation, Flow rates, Hydrograph analysis, Flood forecasting, Kinematic waves.

The problem of calculating a downstream hydrograph from a known upstream hydrograph is known as the flood-routing problem. Singular perturbation techniques were used to obtain an approximate solution of the problem. The first-order outer solution is given by the kinematic-wave approximation. Singularities in this outer solution then lead to two inner solutions: one that follows a kinematic shock as it moves downstream and one either at the downstream boundary in subcritical flow or at the upstream boundary in supercritical flow. Solutions calculated in each of these subregions allow conclusions to be drawn about the relative importance of various terms in the momentum equation. The inner and outer solutions are combined to obtain composite solutions for flow depths and flow rates. A numerical example is worked. (Shidler-PTT)
W88-07246

CRITERION FOR THE EFFECT OF SUSPENDED SEDIMENT ON NEAR-BOTTOM VELOCITY PROFILES,
Institute of Oceanographic Sciences, Taunton, United Kingdom.
For primary bibliographic entry see Field 2J.
W88-07248

GRADUALLY-VARIED FLOWS IN OPEN-CHANNEL NETWORKS,
Stoner Associates, Carlisle, PA.
A. M. Schulte, and M. H. Chaudhry.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 357-371, 1987. 6 fig, 2 tab, 21 ref.

Descriptors: *Flow, *Gradually-varied flow, *Open-channel flow, *Water surface profiles, *Flow profiles, *Backwater curve, *Steady flow, *Mathematical analysis, Algorithms, Computer programs, Flow discharge.

To compute water-surface profiles in steady-state, gradually-varied flows in open-channel networks, an algorithm is presented which allows computation of the flow depths and discharges at all sections simultaneously instead of presently used step-by-step procedures. This algorithm is accurate, efficient, and suitable for computer solution, and it may be directly used for computing flows in parallel channels or in channel networks without necessitating graphical plots or other trial-and-error procedures. The Newton-Raphson method is used in the solution algorithm, and the resulting Jacobian matrix is transformed into a banded matrix in order to increase accuracy and to reduce computer time and storage. The governing equations are presented in detail and the solution algorithm is included in its entirety. Example problems are solved for illustration purposes and the results compared with those obtained by the fourth-order Runge-Kutta method. (Author's abstract)
W88-07249

EXPERIMENTAL VERIFICATION OF THE DRESSLER CURVED-FLOW EQUATIONS,
George Washington Univ., Washington, DC. International Water Resources Inst.
N. S. Sivakumaran, and V. Yevjevich.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 373-391, 1987. 6 fig, 1, tab, 9 ref, 2 append. NSF Grant CEE-8210793.

Descriptors: *Open-channel flow, *Flow characteristics, *Channel morphology, *Dressler curved-flow equations, *Hydraulic geometry, *Spillways, *Hydraulic geometry, Flow resistance, Unsteady flow, Steady flow, Velocity distribution, Flow velocity, Hydraulic engineering.

The Dressler equations with flow resistance and varying channel width for unsteady free-surface flow over curved beds are presented, and a generalized Bresse profile equation for steady curved-flow is derived. Experimental measurements on steady flow over a highly curved spillway demonstrated that the Dressler equations predict the free surface, the bed pressure, and the tangential flow velocity distribution accurately, but the predictions by the classical Saint-Venant equations are almost meaningless. Since both theories require gradual variations in bed geometry, applications to intervals with rapid changes are not valid. For the small intervals of our spillway geometry where the curvature and its derivative vary rapidly, the Dressler solution shows small, but rapid, variations, whereas actual measurements indicate a more gradual variation over wider intervals. (Author's abstract)
W88-07250

DESIGN OF STABLE ALLUVIAL CHANNELS,
Hydraulics and Coastal Engineering Group, Kuwait Institute for Scientific Research, P. O. Box 24885, Safat, Kuwait.
M. M. Abou-Seida, and M. Saleh.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 433-446, 1987. 6 fig, 3 tab, 6 refs.

Descriptors: *Hydraulic design, *Channels, *Stable channels, *Alluvial channels, *Mathematical models, Alluvium, Channel morphology, Flow rates, Sediment transport, Channel scour, Bed load, Computer models, Mathematical equations, Flow resistance, Sediment discharge, Particle size, Particle shape.

For a channel in an alluvial material stable conditions are achieved through the adjustment of three factors--channel width, channel depth, and channel slope. Upon these factors are imposed rate of flow and rate of sediment transport through the channel. The channel is considered stable if sediment admitted to it is sufficient to balance scour due to bed movement; this definition is sometimes called the live- or mobile-bed design condition. A live-bed model has been developed by coupling the Liu-Hwang resistance equation with the Einstein-Brown sediment-transport concept. Two expressions were used to obtain water depth, bed width, and longitudinal slope for a given water flow, sediment discharge, and particle diameter. A computer program, in which limitations to flow regime and shape factor were imposed, was developed to facilitate the calculation procedure. Field data from stable channels in the United States, Pakistan, India, and Egypt were used to develop the model. Two datasets which were not included in model development--one from the Menufia Canal in Egypt and the other from a channel in Pakistan--were used for its verification; in both cases there was good agreement between values calculated with the model and actual channel data. (Shidler-PTT)
W88-07252

STREAM TEMPERATURE INCREASES AND LAND USE IN A FORESTED OREGON WATERSHED,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
R. L. Beschta, and R. L. Taylor.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 19-25, February 1988. 6 fig, 1 tab, 29 ref.

Descriptors: *Water temperature, *Forest management, *Riparian waters, *Streams, *Forest hydrology, Mountain streams, Logging, Riparian vegetation, Flood peak, Regression analysis, Mathematical studies, Environmental effects, Oregon.

The Salmon Creek Watershed drains 325 sq km of forested terrain in the Cascade Mountains of western Oregon. Over a 30-year period (from 1955 to 1984) average daily maximum and minimum stream temperatures, calculated from the 10 warmest days of each year, have risen 6C and 2C, respectively. In contrast, a small decrease in maximum air temperatures was found over the same period. Regression analysis indicated a highly sig-

nificant ($p < 0.01$) relationship between a cumulative index of forest harvesting and maximum stream temperatures. Maximum temperatures also tended to increase for several years following major peak flow events. The interaction between harvest activity (logging and road construction), changing forest and riparian management practices and the occurrence of natural hydrologic events (peak flows and associated mass soil movements) tend to obscure specific cause-and-effect relationships regarding long-term changes in maximum stream temperature. (Author's abstract)
W88-07273

RELATIONSHIP BETWEEN ANNUAL RUNOFF AND WATERSHED AREA FOR THE EASTERN UNITED STATES,
Northrop Services, Inc., Corvallis, OR.
B. P. Rochelle, M. R. Church, W. A. Gebert, D. J. Graczyk, and W. R. King.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 35-41, February 1988. 5 fig, 1 tab, 25 ref.

Descriptors: *Depth-area-duration analysis, *Annual runoff, *Catchment areas, *Runoff, *Rainfall-runoff relationships, *Acid rain, *Water chemistry, *Topographic mapping, Ungaged streams, Watersheds, Correlation analysis, Mathematical Studies, Data processing, Surface water.

As part of the U.S. Environmental Protection Agency's effort to determine the long-term effects of acidic deposition on surface water chemistry, annual runoff was estimated for about 1,000 ungaged sites in the eastern U.S. using runoff contour maps. One concern in using contour maps was that a bias may be introduced in the runoff estimates due to the size of the 1,000 ungaged sites relative to the size of the watersheds used in developing the maps. To determine if a bias was present the relationship between the annual runoff (expressed as depth) and the watershed area for the Northeast (NE) and Southern Blue Ridge Province (SBRP) was tested using five regional data bases. One short-term data base (1984 Water Year, n = 531) and two long-term data bases (1940-57, n = 134 and 1951-80, n = 342) were used in the NE. In the SBRP one short-term data base (1984 Water Year, n = 531) and one long-term data base (1951-80, n = 60) were used. For the NE and the SBRP, runoff was not directly correlated with watershed area using the five regional data bases. Also, runoff normalized by precipitation was not related to watershed area. (Author's abstract)
W88-07275

EFFECTS OF NO-FLOW RIVER CONDITIONS ON THE PLATTE RIVER WELL FIELD,
Broward County Water Resources Management Division, 115 South Andrews Ave., Room 324, Fort Lauderdale, Florida 33301.
For primary bibliographic entry see Field 5B.
W88-07283

PROJECTION OF URBANIZATION EFFECTS ON RUNOFF USING CLARK INSTANTANEOUS UNIT HYDROGRAPH PARAMETERS,
Louisville Univ., KY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W88-07284

GENERATION AND QUALITY OF STREAMFLOW ON INACTIVE URANIUM TAILINGS NEAR ELLIOT LAKE, ONTARIO,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 2F.
W88-07294

SUMMARY OF FLOOD-FREQUENCY ANALYSIS IN THE UNITED STATES,
Geological Survey, Reston, VA.
W. H. Kirby, and M. E. Moss.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 5-14, December 1987. 42 ref.

Descriptors: *Statistics, *Flood frequency, *Historic floods, *Flood data, *Maximum probable floods, *Frequency analysis, Outliers, United States, Mathematical analysis, Error analysis.

A historical summary is given of some of the main issues of flood-frequency analysis including the adequacy of observational data, the form of the probability distribution, the occurrence and nature of outliers, the role of the Probable Maximum Flood, the inevitability of estimation errors and the use of regionalization and Bayesian methods. The U.S. Federal guidelines (Water Resources Council Bulletin 17) for flood-frequency analysis also are summarized. Although much progress has been made in the past 50 years in the understanding of flood magnitude and frequency, many fundamental problems remain to be solved. (Author's abstract)
W88-07385

GENERAL SURVEY OF FLOOD-FREQUENCY ANALYSIS IN CHINA,
Nanjing Research Institute of Hydrology and Water Resources, No. 1 Xikang Road, Nanjing, Jiangsu Province (P.R. of China).
S.-Q. Hua.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 15-25, December 1987.

Descriptors: *Flood frequency, *Historic floods, *Flood data, *Statistics, *Frequency analysis, China, Mathematical analysis.

Since 1950, China has constructed numerous dams. The design of these dams involved flood-frequency analyses using a combination of gaging station and historical floods. Because the length of record for many of the gaging stations is short, a great deal of importance in such analysis has been placed on flood information available from historical documents that date back over 1,000 years. These historic floods can be beneficially used to enlarge a flood series sample. However, the errors in the historical flood will effect the estimation of the distribution curve. Consequently, an engineer's experience and judgement are essential in developing a reliable distribution curve. Although the engineer can give greater weight to the most reliable floods in the curve to produce the best model, the accuracy of the methodology is affected. Due to the short records of existing gaging stations and the errors involved in determining the magnitude of historical events, the accuracy of design floods in China cannot be improved in the near future. Using more complicated models will only make the process more difficult and increase the errors and subjectivity in the model. Until more accurate long term records are accumulated from the gaging stations, to increase the sample population, the reliability of the distribution curve will not improve. (Author's abstract)
W88-07386

QUANTIFYING PEAK DISCHARGES FOR HISTORICAL FLOODS,
Geological Survey, Atlanta, GA. Water Resources Div.
J. L. Cook.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 29-40, December 1987. 6 fig, 8 ref.

Descriptors: *Peak discharge, *Stage-discharge relations, *Statistics, *Historic floods, *Flood peak, *Flood data, Mathematical analysis, Mannings equation, Errors.

The significant characteristics and uncertainties of four commonly used methods for estimating the peak discharge of a flood are discussed: (1) rating curve (stage-discharge relation) extension; (2) slope conveyance; (3) slope area; and (4) step backwater. Logarithmic extensions of rating curves are based on theoretical plotting techniques that results in straight line extensions provided that channel shape and roughness do not change significantly. The slope-conveyance method and slope-area methods are based on the Manning equation, which requires specific data on channel size, shape and roughness, as well as the water-surface slope for one or more cross-sections in a relatively straight reach of channel. The slope-conveyance method is used primarily for shaping and extending rating curves, whereas the slope-area method is used for specific floods. The step-backwater method, also based on the Manning equation, requires more cross-section data than the slope-area method, but has a water-surface profile convergence characteristic that negates the need for known or estimated water-surface slope. Uncertainties in calculating peak discharge for historical floods may be quite large. Various investigations have shown that errors in calculating peak discharges by the slope-area method under ideal conditions for recent floods (i.e. when flood elevations, slope and channel characteristics are reasonably certain), may be on the order of 10-25%. Under less than ideal conditions, where streams are hydraulically steep and rough, errors may be much larger. The additional uncertainties for historical floods created by the passage of time may result in even larger errors of peak discharge. (Author's abstract)
W88-07387

INVESTIGATION AND REGIONALIZATION OF HISTORICAL FLOODS IN CHINA,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
C.-Z. Luo.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 41-51, December 1987. 6 fig, 1 tab.

Descriptors: *Historic floods, *Flood data, *China, Design floods, Maximum probable floods.

Investigation of historical floods (floods that occurred outside the systematic record) is very valuable in design flood computation, especially in the case of inadequate information at the design site. China has carried out investigations of historical floods on a nation-wide basis since the 1950s. Data on numerous extraordinary floods have been collected and much useful experience has been gained. Two methods have been used to gather information about historical floods: (1) field investigations and (2) detailed surveys of historical literature. For most rivers in China, a survey of historical floods will yield information on the occurrence and magnitude of several severe flood events with a return period of 300-400 years. There are two high-value belts of maximum floods in East China, one along the coastal area and the other distributed along the Yanshan, Taihang, Funiu, Tongbai, and Dabie mountain regions. The Xiao Hinggan Mountains in northeast China and the karst region in southwest China are the areas of lowest maximum flood. (Sand-PTT)
W88-07388

ERRORS IN SLOPE-AREA COMPUTATIONS OF PEAK DISCHARGES IN MOUNTAIN STREAMS,
Geological Survey, Denver, CO.
R. D. Jarrett.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 53-67, December 1987. 1 fig, 2 tab, 33 ref.

Descriptors: *Peak discharge, *Slope-area analysis, *Critical depth method, *Stream discharge, *Flood peak, *Flood frequency, *Flood plains, *Flood data, Frequency analysis, Design floods, Maximum problem floods.

During an evaluation of 70 slope-area measurements on higher-gradient streams (stream slopes >0.002) throughout the U.S., peak discharge measurements were found to be affected by n values, scour, expansion and contraction losses, viscosity, unsteady flow, number of cross sections, state of flow and stream slope. Problems due to measurement error can be as great or greater than 100% and lead to overestimation of the actual peak discharge. This can result in misleading maximum flood values, erroneous flood-frequency analyses and overdesign of flood-plain structures. A brief discussion of these problems, tentative solutions and research needs is presented. The critical-depth method of computing peak discharge provides the most reasonable results in higher-gradient streams. (Author's abstract)
W88-07389

INVESTIGATION AND VERIFICATION OF EXTRAORDINARILY LARGE FLOODS ON THE YELLOW RIVER,
Design Institute, Yellow River Conservancy Commission, Zhengzhou, Henan Province (P.R. of China).
F. Shi, Y. Yi, and M. Han.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 69-78, December 1987. 8 fig.

Descriptors: *Historic floods, *Flood stages, *Stream discharge, *Flood data, *Frequency analysis, Scour, Deposition, Roughness coefficient, Yellow River, China.

The Yellow River has a long recorded history and culture dating back several thousands of years. Available literature and historic relics contain stream flow records and information on extraordinarily large floods. During floods, the silt content of the river is very high, and traces of silt deposited are visible. Distinct traces of silt deposits from past extraordinary floods which occurred 100 or even 200 years ago are still visible today. Such information can be used to determine the magnitude and return period of an exceedingly large flood. Methods and approaches for investigating and verifying flood stages, changes in river sections from scour and deposition, and roughness coefficients of major floods are discussed. The analysis of source zones of major floods and estimation of the frequency of occurrence of major floods are also considered. (Author's abstract)
W88-07390

PALEOFLOOD HYDROLOGY AND EXTRAORDINARY FLOOD EVENTS,
Arizona Univ., Tucson. Dept. of Geosciences.
V. R. Baker.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 79-99, December 1987. 2 fig, 8 tab, 67 ref. National Science Foundation Grants EAR 77-23025, EAR 81-19981 and EAR 8300183.

Descriptors: *Paleohydrology, *Historic floods, *Flood frequency, *Frequency analysis, *Flood data, *Radioactive dating, Carbon radioisotopes, Mass spectrometry.

Paleoflood hydrology is the study of past or ancient flood events. The most accurate technique involves the analysis of slackwater deposits and paleostage indicators (SWD-PSI). Flood discharges calculated by this method can be calibrated through the study of modern floods on gaged rivers. Correlation of multiple SWD-PSI sites along a river reach is used to identify the maximum paleostage achieved by a given flood. Advances in the dating of flood deposits permit estimates of flood frequency to be made extending over a database of thousands of years. The major geochronologic tool is radiocarbon dating of various kinds of organic matter intercalated with the slackwater deposits. An important development is the use of the tandem accelerator mass spectrometer for direct measurement of carbon-14. Tiny blebs of charcoal, seeds and other organics can be analyzed to date ancient flood deposits of hydrological significance. Since SWD-PSI studies yield very accurate determinations of paleoflood ages and magnitudes, there is a pressing need for new statistical procedures that make optimum use of the information content in paleoflood records for flood-frequency analysis. Nevertheless, SWD-PSI paleoflood hydrology has moved beyond the research phase; its use should be encouraged in evaluating past experience of extraordinary floods at appropriate hazardous sites. (Author's abstract)
W88-07391

COMPARISON OF THE LARGEST RAINFALL-RUNOFF FLOODS IN THE UNITED STATES WITH THOSE OF THE PEOPLE'S REPUBLIC OF CHINA AND THE WORLD,
Cascades Volcano Observatory, U.S. Geological Survey, Vancouver, WA 98661.
J. E. Costa.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 101-115, December 1987. 5 fig, 3 tab, 48 ref.

Descriptors: *Flash floods, *Historic floods, *Rainfall-runoff relationships, *Storm runoff, *Flood peak, *Maximum probable floods, *Flood data, *Rainstorms, United States, China.

The maximum historic rainfall-runoff floods measured in the U.S., the People's Republic of China and the world all plot close to a smooth curve of drainage area versus discharge. In the U.S., the possibility that flood peaks were overestimated and the closeness of these peaks to the probable maximum floods suggest that this limiting curve of maximum floods will not significantly change position with more data. Data for future floods that plot above this curve need to be examined carefully. The most likely interpretations for new data points above this curve would be the confusion of a mud or debris flow with a water-dominated flood, or the damming of channels by debris or a landslide and subsequent bursting. In the U.S., excluding Hawaii, the largest measured historic floods in basins less than about 1000 sq km, all occurred in arid and semi-arid areas. In China, the majority of the largest measured historic floods occurred in the east and southeast in basins on the windward side of mountainous areas, and in locations affected by typhoons. One extraordinary flood that exceeds any other recorded flood in the world for the size of the drainage basin in which it occurred is the New Caledonia flood of December 24, 1981 on the Ouaieme River. Worldwide, the largest measured historic floods occurred primarily between 40 deg N and 40 deg S latitude on streams and rivers near coastal areas. (Author's abstract)
W88-07392

ESTIMATING RARE FLOODS BY GEOMORPHOLOGICAL METHODS,
Department of Geography, Nanning Teacher's College, Mingxiu Road, Nanning, Guangxi Province (P.R. of China).
R. Xu, and B. Ye.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 117-124, December 1987. 2 fig, 4 tab, 6 ref.

Descriptors: *Flood frequency, *Flood discharge, *Paleohydrology, *Flood data, *Geomorphology, Meteorology, Geology.

The distinction between the upper alluvial flat and the first terrace is the basis for determining the upper and lower limits of rare floods. A method for estimating rare floods integrates the concepts of geomorphology, hydrology, meteorology and geology. In the area in which the crust is stable or has uplifted slightly, use of the geomorphological methods was successful. The upper valley flat and the first terrace can be distinguished exactly by synthetic methods. Comparing the upper limit of rare flood discharges calculated by the geomorphological method with the 10,000-yr frequency flood discharge, an agreement within 27% is seen. The advantages of this method are that it is very simple and can be used whether or not hydrologic and meteorological data are available in the region. Because analysis methods are not completely developed, there exist some differences when the cross-section of a modern river is used to represent that of an original river. This problem is expected to be solved in the near future. (Sand-PTT)
W88-07393

LINEAR ERROR ANALYSIS OF SLOPE-AREA DISCHARGE DETERMINATIONS,
Geological Survey, Reston, VA.
W. H. Kirby.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 125-138, December 1987. 2 fig, 3 tab, 9 ref.

Descriptors: *Slope-area analysis, *Peak discharges, *Discharge capacity, *Flood discharge, *Flood peak, *Flood data, *Mathematical analysis, Error analysis, Scour, Channel scour, Channel morphology, Error analysis.

The slope-area method can be used to calculate peak flood discharges when current-meter measurements are not possible. This calculation depends on several quantities, e.g. water-surface fall, that are not subject to large measurement errors. Other critical quantities, e.g. Manning's n, are not even amenable to direct measurement but can only be estimated. Finally, scour and fill may cause gross discrepancies between the observed condition of the channel and the hydraulic conditions during the flood peak. The effects of these potential errors on the accuracy of the computed discharge were estimated by statistical error analysis using a Taylor-series approximation of the discharge formula and the well-known formula for the variance of a sum of correlated random variates. The resultant error variance of the computed discharge is a weighted sum of covariances of the various observational errors. The weights depend on the hydraulic and geometric configuration of the channel. The mathematical analysis confirms the rule of thumb that relative errors in computed discharge increase rapidly when velocity heads exceed the water-surface fall, when the flow field is expanding and when lateral velocity variation (alpha) is large. It also confirms the extreme importance of assessing the presence of scour or fill accurately. (Author's abstract)
W88-07394

EXTRAORDINARY FLOODS IN EARLY CHINESE HISTORY AND THEIR ABSOLUTE DATES,
Earth and Space Sciences Division, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109.
K. D. Pang.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 139-155, December 1987. 1 fig, 33 ref.

Descriptors: *Historic floods, *Dating, *Flood data, *China, Radioactive dating, Archaelogy.

The earliest extraordinary floods recorded in Chinese historical texts occurred shortly before the beginning of Xia, the first hereditary dynasty in China. Three different methods have been applied to absolutely date these events, using royal genealogies, and records of an ancient solar eclipse and a planetary conjunction. The genealogies, which have been confirmed by archeological data, have been used to calibrate the parallel but not yet confirmed Xia royal genealogy. Using 30 years as an average time interval between two generations and backtracking from known endpoints the beginning of the Xia dynasty was determined to be not earlier than 20th century B.C. Dating of a recorded solar eclipse placed the 5th year of the 4th Xia king at 1876 B.C. Textual records of the 1953 B.C. five-planet conjunction have been found, and the event was shown to have occurred in the lifetime of King Yu. The evidence suggests that the Xia dynasty began in the middle of the 20th century B.C., and the extraordinary floods during the reigns of the sage kings Yao and Shun occurred shortly before that, i.e., in the first half of the 20th century B.C. Radiocarbon dates from the Erlitou and Gaocheng cultures, generally believed to be Xia cultures, are consistent with these results. In view of this analysis and recent archeological discoveries the traditional dates for the beginning of Xia and the earliest recorded extraordinary floods require drastic revision. (Author's abstract)
W88-07395

USE OF HISTORICAL RECORDS IN FLOOD FREQUENCY ANALYSIS,
Institute of Hydrology, Wallingford (England).
J. V. Sutcliffe.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 159-171, December 1987. 4 fig, 4 tab, 24 ref.

Descriptors: *Historic floods, *Flood frequency, *Frequency analysis, *Flood data, Statistical analysis, Graphs, Estimating.

The incorporation of historical information in flood frequency analysis can greatly increase the period over which floods are sampled and decrease the amount of extrapolation necessary. With proper statistical treatment this should improve the confidence with which the magnitude of rarer floods can be assessed and can amend dramatically the flood estimate. This paper describes the forms which historical information can take, some of the problems of interpretation of this information, and reviews some of the methods of analysis. Examples are drawn from different regions including the

Trent, Yangtze and Nile rivers. The emphasis is on the interpretation of the historical record and on graphical presentation of the results, rather than the development of statistical techniques of analysis. (Sand-PTT)
W88-07396

PROBLEMS IN STATISTICAL TREATMENT OF FLOOD SERIES,
Anhui Water Resources Research Institute, 110 Zhihuai Road, Bengbu, Anhui, Province (P.R. of China).
G.-Y. Jin.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 173-184, December 1987. 4 fig, 1 tab, 11 ref.

Descriptors: *Flood data, *Flood frequency, *Frequency analysis, *Statistics, *Statistical methods, Moment method, Errors, Sampling, Hydrology.

This paper discusses some common hydrologic problems in the statistical treatment of flood series associated with the calculation of flood frequency. These problems are: (1) the assumptions used in flood frequency estimation; (2) the moment method and the moment-calculation error; (3) the application of the empirical frequency formula to extraordinary floods; (4) individual curve fitting method; (5) sampling error; (6) computation of combined frequencies; and (7) frequency estimation in the presence of zeros in the series. In addition, other problems, e.g., the accuracy of statistical calculations, the combination of hydrologic events and the reasonableness of derived results, are discussed. (Author's abstract)
W88-07397

PROBABILITY PLOTTING POSITION FORMULAS FOR FLOOD RECORDS WITH HISTORICAL INFORMATION,
Geological Survey, Reston, VA.
R. M. Hirsch.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 185-199, December 1987. 5 fig, 3 tab, 19 ref.

Descriptors: *Statistics, *Historic floods, *Flood data, *Flood frequency, *Frequency analysis, *Statistical methods, Estimating, Errors, Curve-fitting, Bias, Statistics.

For purposes of evaluating fitted flood frequency distributions or for purposes of estimating distributions directly from plots of flood peaks vs. exceedance probabilities (either by subjective or objective techniques), one needs a probability plotting position formula which can be applied to all of the flood data available: both systematic and historic floods. Some of the formulas in use are simply extensions of existing formulas (e.g. Hazen and Weibull) used on systematic flood records. New plotting position formulas proposed by Hirsch and Stedinger 1986 and in this paper are based on a recognition that the flood data arises from partially censored sampling of the flood record. The theoretical appropriateness, bias in probability and bias in discharge of the various plotting position formulas are considered. The methods are compared in terms of their effects on flood frequency estimation when an objective curve-fitting method of estimation is employed. Consideration is also given to the correct interpretation of the historical record length and the effect of incorrectly assuming that record length equals the time since the first known historical flood. This assumption is employed in many flood frequency studies and may result in a substantial bias in estimating design flood magnitudes. (Author's abstract)
W88-07398

DETERMINATION OF CONFIDENCE INTERVALS FOR DESIGN FLOODS,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
S. Hu.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 201-213, December 1987. 1 fig, 3 tab, 13 ref.

Descriptors: *Statistics, *Confidence intervals, *Design floods, *Flood frequency, *Frequency analysis, *Flood data, *Statistical methods, Probability distribution, Simulation, Monte Carlo method.

Confidence intervals for design floods often can be used to measure the precision of a flood frequency curve. This paper analyzes and discusses the determination of confidence intervals for design floods using the Pearson Type III distribution with a known skewness and related problems. A review of the methods proposed in Bulletins 17A and 17B by the U.S. Water Resources Council and the method based on asymptotic theory shows that these methods do not preserve the desired confidence level due to the approximations inherent in the methods, and that the biases from the desired confidence level increase as the skewness coefficient increases. Tables for the confidence factors based on moment and curve-fitting estimates were developed by the Monte Carlo simulation technique and were used to construct the confidence intervals for frequency curves. A numerical example is given to illustrate the application of confidence intervals in a discontinuous sample consisting of historical floods and systematically observed floods. The performance of methods using tables presented herein, the method of B values based on the curve-fitting method and the method suggested by Stedinger are evaluated. The evaluation criterion is that the expected length of the confidence intervals be as short as possible at the desired confidence level. (Author's abstract)
W88-07399

USE OF HISTORICAL INFORMATION IN A MAXIMUM-LIKELIHOOD FRAMEWORK,
Geological Survey, Reston, VA.
T. A. Cohn, and J. R. Stedinger.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 215-223, December 1987. 4 fig, 36 ref. U.S. Geological Survey and National Science Foundation Presidential Young Investigator award CEE-8351819.

Descriptors: *Historic floods, *Flood recurrence interval, *Paleohydrology, *Flood data, *Statistics, Probability, Estimating.

This paper discusses flood-quantile estimators which can employ historical and paleoflood information, both when the magnitudes of historical flood peaks are known, and when only threshold-exceedance information is available. Maximum likelihood, quasi-maximum likelihood and curve fitting methods for simultaneous estimation of 1, 2, and 3 unknown parameters are examined. The information contained in a 100 yr record of historical observations, during which the flood perception threshold was near the 10 yr flood level (i.e., on average, one flood in ten is above the threshold and hence is recorded), is equivalent to roughly 43, 64 and 78 years of systematic record in terms of the improvement of the precision of 100 yr flood estimators when estimating 1, 2, and 3 parameters, respectively. With the perception threshold at the 100 yr flood level, the historical data was worth 13, 20 and 46 years of systematic data when estimating 1, 2 and 3 parameters, respectively. (Author's abstract)
W88-07400

DISCUSSION ON THE EXTRAPOLATION OF HYDROLOGIC SERIES,
Tanjin Design Institute, Ministry of Water Resources and Electric Power, Tianjin (P.R. of China).
For primary bibliographic entry see Field 7C.
W88-07401

EFFECT OF DISCHARGE MEASUREMENT ERROR IN FLOOD FREQUENCY ANALYSIS,
East China Technical Univ. of Water Resources, Nanjing. Dept. of Hydrology.
S. Cong, and Y. Xu.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 237-254, December 1987. 3 fig, 5 tab, 10 ref.

Descriptors: *Historic floods, *Data interpretation, *Error analysis, *Flood data, *Flood frequency, *Frequency analysis, Outliers, China, Probability distribution, Estimating, Moment method, Monte Carlo method.

Observed hydrological data are usually assumed to be accurate when performing a flood-flow frequency analysis. A great deal of research has been conducted to determine flood frequency under this assumption. However, all flood data are subject to some measurement error and the effect of this error on frequency analysis is not well documented. There are only a few studies which have dealt with this subject and their conclusions are generally inconsistent. The major emphasis of this study was to demonstrate the effects of measurement error on the results of a flood flow frequency analysis. The Pearson Type III distribution was mainly used in the analysis, although the log-Pearson Type III was also used. To estimate the distribution parameters, the moment method was used as well as the curve-fitting method, which is the prescribed technique for parameter estimation in hydrological frequency analysis in China. Unbiased and efficiency of the 100 yr and 1000 yr design event estimates are taken as the major criteria for comparing the goodness of fit in frequency analysis. Results from the Monte Carlo method of generating sequentially synthetic hydrological records indicate that in the absence of historical outliers, the effects of small measurement errors are themselves small and may be neglected. When a historical outlier whose error parameter is smaller than 0.3 is included in the analysis, the resulting frequency curve is improved. (Author's abstract)
W88-07402

REGIONAL REGRESSION OF FLOOD CHARACTERISTICS EMPLOYING HISTORICAL INFORMATION,
Geological Survey, Reston, VA.
G. D. Tasker, and J. R. Stedinger.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 255-264, December 1987. 6 fig, 11 ref.

Descriptors: *Statistics, *Flood data, *Historic floods, *Regression analysis, Monte Carlo method, Stream gaging, Estimating, Simulation, Least square method.

Streamflow gauging networks provide hydrological information for use in estimating the parameters of regional regression models. These models can be used to estimate flood statistics, e.g. the 100 yr peak, at ungauged sites as functions of drainage basin characteristics. A recent innovation in regional regression is the use of a generalized least squares (GLS) estimator that accounts for unequal station record lengths and sample cross correlation among the flows. However, this technique does not account for historical flood information. A method is proposed to adjust this generalized least squares (GLS) estimator to account for possible information about historical floods available at some stations in a region. The historical information is assumed to be in the form of observations of all peaks above a threshold during a long period outside the systematic record period. A Monte Carlo simulation experiment was performed to compare the GLS estimator adjusted for historical floods with the unadjusted GLS estimator and the ordinary least squares estimator. Results indicate that using the GLS estimator adjusted for historical information significantly improves the regression model. (Author's abstract)
W88-07403

PROBABLE MAXIMUM PRECIPITATION FOR DESIGN FLOODS IN THE UNITED STATES,
National Weather Service, Silver Spring, MD. Office of Hydrology.
For primary bibliographic entry see Field 2B.
W88-07404

STUDY OF DESIGN STORMS IN CHINA,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
For primary bibliographic entry see Field 2B.
W88-07405

ANALYSIS OF THE DESIGN STORM TIME-INTENSITY PATTERN FOR MEDIUM AND SMALL WATERSHEDS,
Hydrological General Station of Guangdong Province, Canton (P.R. of China).
For primary bibliographic entry see Field 2B.
W88-07407

DETERMINATION OF DESIGN FLOODS USING STORM DATA,
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 2B.
W88-07408

ROLE OF UNCERTAIN CATCHMENT STORM SIZE IN THE MOMENTS OF PEAK STREAMFLOW,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson, and W. Qinliang.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 329-344, December 1987. 8 fig, 15 ref.

Descriptors: *Peak discharge, *Model studies, *Flood peak, *Flood frequency, *Catchment areas, *Storms, *Kinematic wave theory, Regional floods, Mathematical models.

The mean and variance of peak storm runoff from an idealized catchment-stream element were derived using the kinematic wave approximation and incorporating uncertainty in the catchment area covered by the storm as well as in the storm size, intensity, and duration. The results demonstrate a sharp decrease in both the mean and variance of peak streamflow as the ratio of catchment size to predominant storm size increases from the zero value which corresponds to one-dimensional treatment of flood generation. The results provide a theoretical basis for regionalization of flood frequency in cases where the catchment/storm scale ratio is not negligibly small. (Author's abstract)
W88-07409

RESEARCH ON STATISTICAL ESTIMATION OF STORM TRANSPOSITION,
Northwest China Hydroelectric Investigation and Design Institute, Ministry of Water Resources and Electric Power, Xian, Shaanxi Province (P.R. of China).
W. Wang.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 345-354, December 1987. 3 fig, 2 tab, 8 ref.

Descriptors: *Statistics, *Design storms, *Rainstorms, *Probable maximum precipitation, Statistical methods, China.

A systematic analysis of various methods the statistical estimation of storm transposition is presented and the results calculated using these methods compared with those obtained from the national Chinese isoline maps of rainfall parameters and Probable Maximum Precipitation (PMP). The mean value ratio method is suitable for PMP transposition but unsuitable for design storm transposition with a return period concept. On the other hand, statistical methods of storm transposition correlated with Cv, Phi or Km are comparatively suitable for design storm transposition but unsuitable for PMP transposition. Special attention should be paid in choosing any of these methods. A suggested graphical method using the modulus coefficient Kp for transposing design storms is found applicable and simple. (Author's abstract)
W88-07410

STUDY OF THE RELATIONSHIP BETWEEN STORM RAINFALL AND FLOOD BASED ON ANALYSIS OF THE '83.7' FLOOD AT ANKANG IN THE HAN RIVER BASIN,
Haihe River Water Conservancy Commission, MWREP, Tianjin (P.R. of China).
Y. Feng, and C.-C. He.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 355-363, December 1987. 4 fig, 3 tab, 7 ref.

Descriptors: *Rainstorms, *Flood frequency, *Flood data, *Design floods, *Design storms, Frequency analysis, Han River basin, China, Statistical analysis, Storms.

An extreme flood with a peak flow of 31,000 cu m/s and a return of about 200 yr occurred on July 31, 1983, at Ankang in the Han River basin. However, the areal rainfall depth that produced the flood had a recurrence interval of about 15 yr. The main characteristics and frequency of the '83.7'storm flood were analyzed. If the time and space distribution of the '83.7' storm is unchanged and a rainfall depth of a specified return period is applied, the resultant peak flows would be 1.5-1.6 times as large as those obtained by frequency analysis. The spatial pattern of the '79.7' storm was also analyzed. If the time and space distribution of this storm is unchanged and a rainfall depth of a specified return period is applied, the resulting peak flows would be 60-70% of those obtained by frequency analysis. It is concluded that the traditional idea that a design flood with a given return period is produced by a design storm with the same return period is unacceptable. (Sand-PTT)
W88-07411

INFLUENCE OF VARIATION IN FOREST COVER ON DESIGN FLOODS,
Northeast Hydroelectric Investigation and Design Institute, MWREP, Changchun, Jilin Province (P.R. of China).
Y. Liu.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 367-374, December 1987. 5 fig, 4 tab, 3 ref.

Descriptors: *Design floods, *Historic floods, *Rainfall-runoff relationships, *Forests, *Rainfall, *Storm runoff, China, Forest watersheds.

To study the effect of variation in forest cover on the homogeneity of floods, data from 23 stations, each with a drainage area $< 1{,}500$ sq km, in the Changbaishan region in China were analyzed and compared. Some of the drainage areas are heavily wooded and some have almost no woods. The data series of these stations contain almost 30 years of record from 1960s to 1980s. The observed data clearly show the runoff characteristics of both wooded and unwooded areas. With equal rainfall amounts, the peak flows from the wooded areas are lower than those from the unwooded areas. It is shown in the calculation that if the effect of the variation in forest cover on floods is not considered in dealing with the earlier historic floods, which occurred when the area had better forest cover, the mixed-sample design flood, used for the now unforested area, would be on the low side. (Author's abstract)
W88-07412

PROBLEMS WITH OUTLIER TEST METHODS IN FLOOD FREQUENCY ANALYSIS,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
S. Hu.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 375-383, December 1987. 2 tab, 9 ref.

Descriptors: *Flood frequency, *Frequency analysis, *Flood data, *Historic floods, *Outliers, Statistical analysis.

In flood frequency analysis, the term 'outlier' is commonly used to denote large floods in the systematic record or historical floods which lie far above the majority of the floods in the sample. The mere existence of these outliers complicates the frequency analysis procedure. In order to avoid any subjectivity in the detection and treatment of outliers, the U.S. Weather Resources Council (WRC) recommended a method based on the principles of hypothesis testing. In spite of the fact that it has been extensively applied in the U.S., there are some theoretical and practical aspects which require further consideration. A study of principles reveals that outlier tests in a statistical context postulate an assumption that outliers have a unique distribution which is different from that of the remaining sample observations. Thus, the theory underlying the outlier test is in conflict with the phenomenon of outliers in flood data because it is generally accepted that both historical floods and extraordinary floods in systematic records all come from a common unknown population including all floods. Consequently it would not be reasonable to introduce outlier tests into a flood frequency analysis. The 'masking effect' encountered in the practical use of the outlier test method in WRC (1981) is analytically discussed. Observed flood records at several stations are used to illustrate that the test in WRC Bulletin 17B does not guarantee the detection of outliers if more than one is present in the sample due to this masking effect. (Author's abstract)
W88-07413

COMPUTATION OF SUPERCRITICAL FREE-SURFACE FLOWS,
Instituto Costarricense de Electricidad, San Jose.
For primary bibliographic entry see Field 8B.
W88-07430

EFFECT OF INTERSITE DEPENDENCE ON REGIONAL FLOOD FREQUENCY ANALYSIS,
IBM Research Div., Yorktown Heights, NY.
J. R. M. Hosking, and J. R. Wallis.
Water Resources Research WRERAO, Vol. 24, No. 4, p 588-600, April 1988. 13 fig, 7 tab, 19 ref.

Descriptors: *Regional analysis, *Stochastic process, *Mathematical studies, *Flood forecasting, *Flood frequency, Intersite dependence Floods, Estimating, Statistics.

Regional flood frequency analysis usually assumes that flood records from different sites are statistically independent. This assumption is unlikely to be valid in practice, so it is important to know how intersite dependence affects flood quantile estimates obtained by regional analysis. Monte Carlo simulation was used to assess the effect of realistically specified intersite dependence on the regional probability weighted moment algorithm, a robust and efficient procedure for regional flood frequency analysis. Any bias in flood quantile estimated is unchanged by the presence of intersite dependence. The accuracy of flood quantile estimates decreases when intersite dependence is present, but this effect is less important for practical applications than the bias in flood quantile estimates due to heterogeneity (inequality of the flood frequency distributions in the region). Even when both heterogeneity and intersite dependence are present and the form of the flood frequency distribution is misspecified, regional flood frequency analysis is more accurate than at-site analysis. (Author's abstract)
W88-07449

PREDICTION OF FLOOD FREQUENCY IN SAUDI ARABIA,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
M. A. Nouh.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 85, No. 2, p 121-144, March 1988. 2 fig, 10 tab, 27 ref. KACST Operating Grants AR-2-17 and AR-5-62.

Descriptors: *Flood forecasting, *Regional analysis, *Model studies, *Drainage area, *Saudi Arabia, Mathematical studies, Design criteria, Flow, Rainfall.

Three methods of flood prediction, reported in the United Kingdom Natural Environmental Research Council Flood studies report, have been investigated, using the records of 32 gauged stations in the south-west region of Saudi Arabia. In the first method, regional curves were developed and used together with the mean annual flood flow, estimated from the characteristics of the drainage basin, to estimate flood flows at a location in the basin. The second method was to estimate the annual maximum rainfall depth for a given duration and for a given return period over a drainage basin, and then to use such an estimate together with commonly used peak flow models to predict the annual maximum flood flow for the return period in the drainage basin. In the third method, flow duration re-

duction were developed and used together with the mean annual calendar day flood flow, estimated from the characteristics of the drainage basin, to predict the peak flood flow for different return periods in the drainage basin. Each of the three methods was verified by being applied in six different drainage basins. On the basis of the results obtained, recommendations were made on the best method to be applied (at present) by design engineers. (Author's abstract)
W88-07477

SECONDARY CURRENTS IN STRAIGHT WIDE CHANNELS,
Democritus University of Thrace, 67100 Xanthi, Greece.
N. E. Kotsovinos.
Applied Mathematical Modeling, Vol. 12, No. 1, p 22-30, February 1988. 1 fig, 17 ref.

Descriptors: *Transverse flow, *Water currents, *Stream stabilization, *Open-channel flow, *Turbulent flow, Hydrodynamics, Streamflow, Fluid flow, Channel flow.

Transverse flow (commonly known as secondary flow), which exists for fully developed turbulent flow in straight channels of noncircular cross section was examined. The basic macroscopic features of this secondary flow in straight wide channels can be found, assuming that the axial mean flow is in hydrodynamic instability, which is the result of a competition between destabilizing and stabilizing effects. The two opposite effects in the rectilinear flow are the normal stresses that tend to produce a motion of the fluid away from the wall and the viscosity v that tends to prevent this motion. It is predicted that the width of the secondary flow cells in a straight wide channel is equal to the depth of the flow. Experimental evidence agrees with this finding. (Author's abstract)
W88-07493

SEEPAGE FROM CHANNELS AND PONDS WITH IMPERVIOUS BOUNDARY WALLS EXTENDING BELOW FLOOR LEVEL,
Soils Division, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ (U.K.).
For primary bibliographic entry see Field 2G.
W88-07510

PARAMETER ESTIMATION MODEL FOR UNGAGED STREAMFLOWS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
U. Lall, and J. Olds.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 245-262, July 15, 1987. 1 fig, 3 tab, 3 ref.

Descriptors: *Streamflow forecasting, *Ungaged streams, *Gaging stations, *Mathematical models, *Water resources development, *Hydrology, *River basin development, Mass balance, Least squares method, Melt water.

Proper determination of streamflow quantities and their mass balance is essential for efficient and equitable river basin management and water allocation. It provides the baseline data for the decision making process. Unfortunately, it is practical to measure river flows only at specified gaging stations, and local inflow/outflow characteristics between gages are not quantitatively known. The knowledge of these inflows/outflows is critical from an operational perspective, particularly if flow regulation or modification is considered. A constrained nonlinear least squares model is presented that seeks to minimize the error in selecting hydrologic parameters that can help predict monthly, local inflows/outflows for a stream section between gages. Of interest is the prediction of ungaged, local inflows from rainfall and snowmelt, local inflows/outflows to the groundwater regime, and return flows from irrigation diversions. The minimization of the squared error in satisfying the monthly mass balance for the stream section is considered as the optimizing criteria, and a number of constraints are imposed to incorporate prior knowledge and to ensure a unique and well behaved solution. Physical and meteorological factors such as temperature, precipitation, drainage access, channel lengths, channel slopes, and elevation are correlated with the hydrological data base at the location to derive the parameter estimates. The parameter estimation model is general in nature and can be applied to a wide variety of stream sections. The model formulated is solved using successive linear programming. Applications procedures and a selected example application are reviewed. (Author's abstract)
W88-07513

BUSHFIRE HYDROLOGY - THE CASE OF LEAKING WATERSHEDS,
A.C.T Water Authority, G.P.O. Box 863, Canberra City, A.C.T. 2601 (Australia).
For primary bibliographic entry see Field 2A.
W88-07517

SOME NEW PERSPECTIVES ON THE PROBABILISTIC MODELING OF FLOODS,
California Univ., Davis. Dept. of Civil Engineering.
M. L. Kavvas.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 315-331, July 15, 1987. 7 fig. 32 ref. NSF Grant CEE-8411896.

Descriptors: *Routing, *Flood routing, *Flood hydrographs, *Probabalistic models, *Precipitation, Model studies, Stochastic processes, Reservoirs, Floods, Flood control.

In the design of a flood control system a flood hydrograph realization, corresponding to a stated risk is taken as the hydrograph to be routed through the system. In general, floods come in groups and form multipeaked hydrographs. A multipeaked flood hydrograph (or a group of floods) when routed through a reservoir-levee-wall flood control system may yield a more critical result than routing a single-peaked hydrograph even if each of the peaks in the multipeaked hydrograph is smaller than the peak of the single-peaked hydrograph. This is due to the fact that while the earlier floods within a flood group may not be critical for the system, they may still fill the reservoir to a critical level so that the later floods in the flood group are passed by the reservoir directly downstream and, thereby, cause damage downstream. Similar arguments also follow for the flood levees and flood walls on the river reach downstream of a reservoir, since there is a channel storage during the passage of a flood wave through the river channel. Also due to storage in the system, not only the peak discharge stochasticity but the stochasticity of the complete flood hydrograph shape needs to be described. Instead of basing the probabilistic description of flood realizations on a single peak discharge, stochastic models were developed for the complete shape of generally multipeaked continuous time-flood realizations. First, a point stochastic model of the multistation precipitation process is presented. Using precipitation as the driving process of floods, a three-dimensional point stochastic model for the flood starting times,times to peaks and peak magnitudes is presented. A stochastic model for the continuous-time flood realizations, as an extension of the previous three-dimensional point stochastic model, is discussed. (Author's abstract)
W88-07518

NEGATIVE PHASE SHIFT OF GROUNDWATER TIDES NEAR SHALLOW TIDAL RIVERS - THE GOUDERAK ANOMALY,
Research Department, The netherlands Waterworks Testing and Research Institute KIWA Ltd., P.O. Box 1072, 3430 BB Nieuwegein (The Netherlands).
C. Maas, and W. J. De Lange.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 333-349, July 15, 1987. 10 fig, 11 ref.

Descriptors: *Surface-groundwater relations, *Tides, *Groundwater movement, *Hollandsche Ijssel River, *Aquifers, *Aquitards, *Tidal rivers, Mathematical equations, Rivers, Groundwater, Piezometers.

During a site investigation at Gouderak, The Netherlands, the observation was made that groundwater tides in several piezometers near the shallow tidal river Hollandsche Ijssel were running ahead of the river by more than an hour. Although the current theory of groundwater flow does not account for this effect, the phenomenon can be explained by means of well known elementary mechanisms. The superposition principle is used to derive formula for the phase shift and the attenuation for the case of a single aquifer covered by an aquitard. For this simple system the maximum negative phase shift at the river bank amounts to 0.25 pi radians (corresponding to 1.5 hours for the semidiurnal tidal component). (Author's abstract)
W88-07519

KINEMATIC OVERLAND FLOW - GENERALIZATION OF ROSE'S APPROXIMATE SOLUTION, PART II,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
I. D. Moore, and P. I. A. Kinnell.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 351-362, July 15, 1987. 6 fig, 6 ref. Australian Water Research Advisory Council Grant Project 85/131.

Descriptors: *Mathematical models, *Surface runoff, *Rainfall-runoff relationships, *Kinematic flow, *Kinematic wave theory, *Overland flow, Hydrograph analysis, Flow, Model studies, Rainfall, Mathematical equations, Runoff.

The approximate kinematic overland flow equation derived by Rose et al. and generalized by Moore includes a water surface profile shape factor C. Rose et al. assumed a constant $C = 0.625$. The variation of C as a function of normalized discharge q^* was examined during various phases of the overland flow hydrograph rise and recession under constant and time-varying rainfall excess. The possible range of C values is bounded by rising and falling limb boundary curves. These vary linearly from $C = 1$, $q^* = 0$ to $C = 0.625$, $q^* = 1$ (steady state or equilibrium) during the hydrograph rise and linearly from $C = 0.625$, $q^* = 1$ to $C = 0.4$, $q^* = 0$ during the recession. At any time during an event the value of C depends on both the value of q^* and its previous pattern of variation or history. Analytical equations are presented that allow C to be estimated during a runoff event, thus permitting improved predictions of overland flow on plane surfaces using the approximate theory without any increase in computational complexity. (Author's abstract)
W88-07520

SIMPLE MATHEMATICAL MODEL OF A COMPLEX HYDROLOGIC SYSTEM - OKAVANGO SWAMP, BOTSWANA,
For primary bibliographic entry see Field 2A.
W88-07524

IMPROVED FLOOD ROUTING BY ARMA MODELLING AND THE KALMAN FILTER TECHNIQUE,
Academia Sinica, Beijing (China). Inst. of Geography.
W. Guang-te, Y. Yu, and W. Kay.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 175-190, August 15, 1987. 2 fig, 2 tab, 13 ref, append.

Descriptors: *Flood routing, *Flood forecasting, *Mathematical models, *Routing, *Errors analysis, *Hydrographs, *Flood control, *Yangtze River, *China, Floods, Rivers, Model studies, Autoregressive moving average model, Kalman filter, Mathematical equations.

Conjunctive use of an autoregressive moving average (ARMA) model and a Kalman filter for hydrologic river routing is suggested and applied to route the 1974 flood of the Changjiang (Yangtze) River in China. For this particular flood, the results show that the Kalman filter accounts for 30%-40% of the variance accounted for by the

ARMA model with fixed coefficients. Combined use of the Kalman filter and an autoregressive and moving average model for hydrologic river routing provides optimal estimates of the flood hydrograph with the least error variance. (Author's abstract)
W88-07533

NITRIFICATION IN ONTARIO STREAM SEDIMENTS,
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
M. D. Wyer.
Water Research WATRAG, Vol. 22, No. 3, p 287-292, March 1988. 3 fig, 5 tab, 18 ref.

Descriptors: *Streams, *Sediments, *Nitrification, *Nutrients, *Fate of pollutants, *Cycling nutrients, *Path of pollutants, Bottom sediments, Ontario, Nitrates, Ammonia, Organic matter.

Nitrate production in the 0-1 cm depth of stream sediments was investigated in a wide range of sediment types from five areas in southern Ontario. Sediment types were fine, organic, sandy plain, coarse, low pH, and medium. Nitrification rates ranged from 0-128 mg/sq m/day in laboratory incubations. The highest rates were associated with fine textured and organic samples. Nitrate production was significantly correlated with sediment clay content ($r = 0.77$). This relationship may be partially indirect in that fine textured sediments tend to have a larger source of substrate for nitrification. High clay and organic matter content may also provide more exchange sites for ammonium ions. Weaker significant positive correlations were found between the nitrification rate and ammonium-N, organic carbon, and total N contents. (Cassar-PTT)
W88-07539

DEVELOPMENT OF FLOOD FORECASTING AND WARNING SYSTEM IN CHI AND MUN RIVER BASINS, NORTHEAST THAILAND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
T. Tingsanchali.
Water Resources Journal, No. 154, p 31-44, September 1987. 11 fig, 16 ref.

Descriptors: *Rivers, *Flood forecasting, *Reservoir operation, *Flood routing, Model studies, Chi River, Mun River, Pong River, Ubon Ratchathani Reservoir, Thailand, SSARR model, DFR model, Mathematical models, Rainfall, Forecasting, Warning stage.

A flood routing model for forecasting floods and a flood warning procedure were developed for the Pong, Chi, and Mun River basins in Thailand. This drainage area of 11,900 sq km experienced a 500-year flood in 1978 during which reservoirs filled and flooding was severe. This region is characterized by low banks and flat slopes. Two mathematical models, the SSARR watershed model and the DFR (dynamic flood routing) model, were calibrated for the basin using data on rainfall, streamflow, evaporation, reservoir inflow, reservoir levels, and reservoir releases for the wet seasons of 1975, 1978, and 1980 (dry year, very wet year, and wet year, respectively). The SSARR model was used for the whole watershed except for the Lower Mun River where the DFR model was used. In this reach strong backwater effects exist. The most sensitive element was the rainfall forecast. Based on the forecast period of 7 days, the forecast results were found to be quite accurate, providing a good basis for a flood warning system. (Cassar-PTT)
W88-07556

HYDRAULICS AND BASIN MORPHOMETRY OF THE LARGEST FLASH FLOODS IN THE CONTERMINOUS UNITED STATES,
Cascades Volcano Observatory, Vancouver, WA.
J. E. Costa.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 313-338, September 15, 1987. 12 fig, 4 tab, 60 ref.

Descriptors: *Rainfall-runoff relationships, *Floods, *Flood profiles, *Flash floods, *Flood basins, *United States, *Arid climates, *Basins, Basin morphometry, Watersheds, Mathematical studies, Rainfall, Runoff, Froude number.

The maximum rainfall-runoff floods measured by indirect methods in small basins (0.39-370 sq km) in the conterminous United States were examined. This analysis identified 12 floods that were the largest ever measured. These floods all occurred in semiarid to arid areas. For 11 of the 12 largest rainfall-runoff floods measured in small basins by the slope-area method, values of hydraulic depth; hydraulic radius; width-depth ratio; n value; mean velocity; velocity-head coefficient; Froude number; water-surface, energy, and channel slopes; shear stress; and unit stream power are tabulated. Estimated composite n values weighted by subsection conveyance range from 0.028 to 0.048 with a mean of 0.038. Mean velocities ranged from 3.47 to 9.97 m/s. Froude numbers ranged from 0.81 to 2.49, with 9 of 12 floods having values greater than 1.00. Water-surface, energy, and channel slopes vary considerably for each flood. Energy slope always was less than water-surface slope by values of 1-104%. Channel slope was greater than energy slope in eight floods. Shear stresses ranges between 61 and 855 N/sq m, and unit stream power from 212 to 8131 w/m. Floods in these small basins produced shear stresses and unit stream powers several hundred times greater than floods in large rivers. Floods on other small streams, with smaller unit discharges, produced greater shear stresses and stream powers. This indicates that the force of a flood is controlled by the depth-slope product, not absolute discharge. In the 12 watersheds studied, basin relief ranged from 165 to 1280 m, elongation ratios ranged from 0.55 to 0.80, The number of first-order streams (basin magnitude) ranged from 10 to 4297, drainage density ranged from 4.1 to 10.9 km/sq km , basin slope ranged from 0.0043 to 0.2486, relief ratio ranged from 0.0097 to 0.34, ruggedness number ranged from 0.69 to 7.17, and first-order channel frequency ranged from 5.1 to 38.6/sq km. Elongation ratios were larger, and drainage density and first-order channel frequency lower, than other small flash-flood prone basins in the Unites States. Maximum flood peaks originate from an optimal combination of basin morphology and physiography, and storm intensity. (Author's abstract)
W88-07566

AREAL DISTRIBUTION OF INFILTRATION PARAMETERS AND SOME SOIL PHYSICAL PROPERTIES IN LATERITIC CATCHMENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2G.
W88-07573

MECHANISMS OF CATCHMENT FLOW PROCESSES USING NATURAL VARIATIONS IN DEUTERIUM AND OXYGEN-18,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2A.
W88-07575

PREDICTION OF WATER YIELD REDUCTIONS FOLLOWING A BUSHFIRE IN ASH-MIXED SPECIES EUCALYPT FOREST,
Water Supply Division, Melbourne and Metropolitan Board of Works, Box 4342, Melbourne, Vic. 3001 (Australia).
For primary bibliographic entry see Field 4C.
W88-07579

LONG RANGE STREAMFLOW AND WORLD CONTINENTAL RUNOFF FLUCTUATIONS SINCE THE BEGINNING OF THIS CENTURY,
Centre de Sedimentologie et de Geochimie de la Surface, Institut de Geologie, 1 rue Blessig, 67084 Strasbourg Cedex (France).
For primary bibliographic entry see Field 2A.
W88-07582

RELATIONSHIP OF SOIL SURFACE ROUGHNESS WITH HYDROLOGIC VARIABLES ON NATURAL AND RECLAIMED RANGE LAND IN NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.
For primary bibliographic entry see Field 4C.
W88-07585

TRANSIENT ACID SURGES IN AN UPLAND STREAM,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W88-07598

EFFECTS OF SEDIMENT AND CONTAMINATED SEDIMENT ON STRUCTURAL AND FUNCTIONAL COMPONENTS OF EXPERIMENTAL STREAM ECOSYSTEMS,
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5C.
W88-07618

RESPONSES OF JUVENILE ATLANTIC SALMON (SALMO SALAR) TO EPISODIC INCREASES IN ACIDITY OF NOVA SCOTIA RIVERS,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 5C.
W88-07642

UNIONID MUSSELS (MOLLUSCA, BIVALVIA) OF THE BELGIAN UPPER RIVER MEUSE: AN ASSESSMENT OF THE IMPACT OF HYDRAULIC WORKS ON THE RIVER WATER SELF-PURIFICATION,
Liege Univ. (Belgium). Zoology Inst.
For primary bibliographic entry see Field 6G.
W88-07670

RUNOFF COLLECTOR AND FLUME FOR USE ON BARE FALLOW PLOTS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 7B.
W88-07694

LOCAL CHANGES OF SALINITY AND NUTRIENTS AND PROCESSES CONTRIBUTING TO THE NUTRIENT DISTRIBUTION OFF THE EVROS RIVER, IN THE NORTH AEGEAN SEA,
Institute of Oceanographic and Fisheries Research, GR-166 04, Hellinikon, Greece.
For primary bibliographic entry see Field 2L.
W88-07695

MODIFIED RUNOFF CURVE NUMBERS FOR BARE CRUST-FORMING SANDY SOILS,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 541-545, 1987. 2 fig, 1 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff curve numbers, *Runoff, *Sand, Soil types, India, Soil Conservation Service Handbook, Comparison studies, Prediction, Regression analysis, Rainfall, Storm runoff, Arid zone, Storm water.

Runoff curve numbers (CN) for bare crust-forming sandy soils in the Indian Arid Zone were derived from rainfall and runoff data recorded over a period of 7 years from 1975 to 1981. Contrary to the Soil Conservation Service (SCS) handbook value of 77, the actual optimized CN for 0.5% and 5-10% slopes were found to be 87 and 91, respectively, indicating a greater volume of generated runoff from these soils than estimated by the SCS method. The handbook CN value underpredicted runoff by 47-68% for storms >100 mm and 163-400% for storms <25 mm. A significant correla-

tion (r=0.898, n=227) was found between the observed and predicted values using a modified CN based on the measurements. (Author's abstract)
W88-07704

AGRICULTURAL MANAGEMENT PRACTICES AND THE INTEGRITY OF INSTREAM BIOLOGICAL HABITAT,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 5G.
W88-07836

DROUGHT CONDITIONS: STAFF SUMMARY,
Susquehanna River Basin Commission, Harrisburg, PA.
D. R. Jackson.
Publication No. 96-1. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. May 1985. 14 p, 11 fig.

Descriptors: *Drought, *Rainfall, *New York, *Pennsylvania, *Susquehanna River, *New York, *Pennsylvania, Seasonal variation, Water shortage, Rainfall intensity, Susquehanna River basin, Weather data collections, Data interpretation.

Rainfall and streamflow data have been analyzed to describe the current drought condition. Data for average monthly rainfall for the months of September 1984 through April 1985 were obtained from the bimonthly Weather summary furnished by the River Forecast Center. The drought was assumed to begin in September 1984 for the following reasons: (1) The rainfall deficiency maps prepared by the Commission staff begin in that month; and (2) September was the first month with a rainfall deficiency. The analyses of rainfall data showed the following: (1) In the 30 years of historical data, there was no occurrence of a basinwide average January rainfall as low as the basinwide average rainfall experienced in January 1985 (0.76 in); (2) The September 1984 basinwide average rainfall was 1.34 in. There was only one September in the 30 years of record which showed a lesser amount, and that was 1.23 in. in 1961; (3) There is only one occurrence in the 30 year record of basinwide average April rainfall less than the basinwide average for April 1985 (1.49 in.). That occurrence was in 1971 (1.11 in.); (4) There are a large number of occurrences of rainfall less than the current individual month values in the remaining months since last September; and (5) In the 30 years of record, there are no occurrences of eight month totals ending in any month which are less than the total of the period September 1984 through April 1985. The streamflow data was analyzed for the following streamgaging stations: Chemung River near Chemung, NY, Susquehanna River near Waverly, NY, Tunkhannock Creek near Tunkhannock, PA, Susquehanna River at Wilkes-Barre, PA, West Branch Susquehanna River at Lewisburg, PA, Juniata River at Newport, PA, Susquehanna River at Harrisburg, PA, and Conodoguinet Creek near Hogestown, PA. (Lantz-PTT)
W88-07845

DROUGHT CONDITIONS: STAFF SUMMARY,
Susquehanna River Basin Commission, Harrisburg, PA.
D. R. Jackson.
Publication No. 96-2. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. June 1985. 10 p, 8 fig.

Descriptors: *Streamflow, *Drought, *Rainfall, *Susquehanna River, *New York, *Pennsylvania, Seasonal variation, Water shortage, Rainfall intensity, Susquehanna River basin, Data interpretation, Weather data collections.

Rainfall and streamflow data have been analyzed to describe the current drought condition. Accumulated departures from normal were computed beginning in September 1984 for basinwide average rainfall. Accumulated departures from normal for each county, computed by National Weather Service beginning in October 1984, are also discussed. The analysis of rainfall data showed the following: (1) Normal basinwide average precipitation for May is 3.53 in. The basinwide average rainfall for May 1985 was 3.47 in. Thus the basinwide average rainfall was almost normal. However, the distribution of rainfall results in a continuation of very large deficits in the New York part of the basin and in the northern counties of Pennsylvania. Most counties in New York show deficits in excess of 1 in. for May, compared to an excess of 1 to 3 in. for most counties in Pennsylvania; (2) The accumulated basinwide average rainfall beginning in September 1984 is 19.74 in., and is typical of low rainfall experienced during the worst of the 1960's drought; (3) The accumulated deficiency from normal which increased rapidly between January and April, increased only slightly in May. The streamflow data was analyzed for the following stations: Chemung River near Chemung, NY, Susquehanna River near Waverly, NY, Susquehanna River at Wilkes-Barre, PA, West Branch Susquehanna River at Lewisburg, PA, Juniata River at Newport, PA, and Susquehanna River at Harrisburg, PA. (Lantz-PTT)
W88-07846

CONTINENTAL WEATHERING OF GERMANIUM: GE/SI IN THE GLOBAL RIVER DISCHARGE,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2K.
W88-07931

SEASONAL AND ANNUAL VARIATIONS IN THE ORGANIC MATTER CONTRIBUTED BY THE ST. LAWRENCE RIVER TO THE GULF OF ST. LAWRENCE,
Department of Fisheries and Oceans, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, N.S., Canada B2Y 4A2.
R. Pocklington, and F. C. Tan.
Geochimica et Cosmochimica Acta, Vol. 51, No. 9, p 2579-2586, September 1987. 4 fig, 4 tab, 36 ref.

Descriptors: *Water quality, *Water chemistry, *Saint Lawrence River, *Organic matter, *Seasonal variation, *Dissolved solids, *Particulate matter, *Estuaries, River flow, Flow discharge, Sediments, Suspended particulate matter, Dissolved organic carbon, Particulate organic carbon, Canada, Annual variation, Water pollution sources, Path of pollutants, Nonpoint pollution sources, Pollution load.

The St. Lawrence River discharges a substantial volume of water (405 cu km/yr) containing suspended (SPM; 3,420,000 t) and dissolved (68,000,000 t) materials to the Gulf of St. Lawrence. The total load contains organic carbon in particulate (POC; 3-14% of SPM), and dissolved (DOC; 3.76 plus or minus 0.63 mg/l) form. The concentration of POC (and particulate organic nitrogen) is positively correlated with discharge (increased during the spring flood and the fall enhancement of flow), but concentration of DOC is not so simply related to discharge. In consequence, the total organic carbon (POC + DOC) load is relatively invariant, and increased annually by only 2-3% despite a progressive increase of 8% in discharge over the years of this study. Seasonal differences in the composition of the particulate organic matter (POM) are interpreted as reflecting dominant contributions from within-river production in summer and from terrestrial sources in spring and fall. In years when the annual discharge was greater than average, a higher proportion of the POM was terrigenous. The organic matter in surface sediments of the estuary to which the river discharges is predominantly of terrestrial provenance. (Author's abstract)
W88-07934

BREAKUP OF SMALL RIVERS IN THE SUBARCTIC,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2C.
W88-07935

PACIFIC NORTHWEST RIVERS STUDY. 1986 FINAL REPORT: IDAHO,
Idaho Dept. of Fish and Game, Boise.
S. Allen, J. Putera, and C. Jazdzewski.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011162. Price codes: A04 in paper copy, A01 in microfiche. Report No. DOE/BP--796, (1986). 88 p, 6 append.

Descriptors: *Idaho, *Rivers, *Water resources data, *Hydrologic data, *Hydroelectric power, Ecosystems, Fish, Wildlife, Recreation, Resources management, Environmental policy, Maps.

The Pacific Northwest Rivers Study was initiated to assess the significance of river segments for a variety of environmental values. The purpose of the study was to identify environmental and institutional considerations which might have a bearing on hydropower development in the northwest. The resource assessment phase of the Rivers Study was initiated in June 1985, and completed in January 1986. This phase produced both tabular information regarding each river segment in the state and a series of maps identifying the location of river segments. Each segment was also assigned to one of the series of resource value classes depending on its relative significance within a given resource category. Subsequent to the initial assessment, information was encoded into computer format and made available for review. This report presents a description of the assessment process and findings for each of the resource categories analyzed in the Idaho component of the Pacific Northwest. (Lantz-PTT)
W88-07963

STREAM HABITAT ENHANCEMENT EVALUATION WORKSHOP: A SYNTHESIS OF VIEWS,
For primary bibliographic entry see Field 2H.
W88-07968

2F. Groundwater

HELIUM SURVEY FOR DELINEATING AREAS OF KARST-SUFFOSION PROCESSES CAUSED BY HIGH-RATE GROUNDWATER WITHDRAWAL,
Water Problems Institute, USSR Academy of Sciences, Moscow, USSR.
V. S. Kovalevsky, and V. L. Zlobina.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 2, p 88-94, 1987. 4 fig, 8 ref.

Descriptors: *Surface-groundwater relations, *Subsidence, *Groundwater depletion, *Groundwater flow, *Geohydrology, *Data acquisition, *Environmental effects, *Helium, *Karst hydrology, Aquifer testing, Suffosion, Sediments, Carbonate aquifers, Moscow, USSR, Tritium, Confined aquifers, Carboniferous aquifers, Groundwater recharge, Recharge, Rivers.

The combined use of helium and tritium surveys effectively delineated areas of intensive exchange of confined, unconfined, and river water under the complex conditions of karst hydrology. The Carboniferous artesian aquifer, located in central Moscow, contains hundreds of pumping wells and has been heavily developed. As a result, the water table has decreased by 50-70 m, interaction between the surficial and the confined aquifers is occurring, solution cavities have formed, groundwater flow velocity has increased 50-100 times, water temperature has increased by 10-12 C in some areas, and water quality has changed. Through this intensification of karst formation and karst-suffosion (suffosion refers to undermining by removal of sediment by groundwater) sinkhole formation and building destruction have occurred. Helium concentrations, determined three times from 1978 to 1983 in areas of active karstification were similar to those of precipitation, about 0.0000510 ml/liter. Computer mapping allowed interpretation of three anomalous areas, all in the Moscow River valley where groundwater interaction with river water is also influenced by V-shaped paleovalleys. The anomalies were confined

to valleys with eroded Jurassic clays, where there is direct contact of Quaternary sandy-clay deposits with carboniferous carbonate rocks. Tritium surveys and hydrogeochemical investigations confirmed the results of the helium surveys. (Cassar-PTT)
W88-06878

GROUNDWATER RESOURCES AND DEVELOPMENT IN CHINA,
Ministry of Geology and Mineral Resources, Beijing, China.
C. Mengxiong.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 3, p 141-147, 1987. 2 fig, 9 tab.

Descriptors: *Water resources development, *Water demand, *Groundwater potential, *Environmental effects, *China, Geohydrology, Water supply, Urbanization, Water demand, Groundwater mining, Groundwater recharge, Recharge, Water storage, Subsidence, Groundwater pollution, Saline water intrusion.

China has total groundwater resources of 872 billion cu m/r. Total water resources, including all sources, are 2804.7 billion cu m/r. The complex hydrogeology of this 9.6 million sq m country has six main divisions: East Plain, with enormously thick unconsolidated sediments forming multiple aquifers; Inner Mongolian and Loess Plateaus; Western Inland Basins, arid desert land with plenty of groundwater in piedmont plains; southeast and Central-south Hilly Land, characterized by exposed rocks and fissure water; Southwest Karst Hilly; and Qing-Zhang Plateau, mainly permafrost. Of the total groundwater resources, 250.3 billion cu m/r is pore water, 417.4 cu m/a is fissure water, and 204 cu m/r is karst water. Exploitation of groundwater is 74.6 billion cu m/r, 11.6% of the groundwater resources. The plain area uses 76%; the hilly region, 24%. Groundwater extraction has allowed the extensive agricultural development (11.3 million ha) in the arid northern plains. More than 400,000 irrigation wells have been sunk in the Hebei Plain during the last 20 yr. Although surface water is abundant in South China, there are certain areas of localized water shortage in the coastal plains, red bed basins, and karst mountainous regions. Groundwater resources have been developed in all these regions, adding thousands of hectares of irrigated land and solving chronic water supply problems in cities. This includes wells, karst springs, and subterranean streams (about 2000 streams). Beijing uses 2500 million cu m of groundwater each year, 60% of the total water supply of the city. Groundwater use in the industrial area of Liaoning reaches 830 million cu m/r. Exploitation of groundwater has caused several problems: water table reductions resulting in reduced yield, drying up of shallow irrigation wells, and pump replacement; land surface subsidence up to 2.4 m, especially in large coastal cities; and seawater intrusion. Pollution from industrial discharges and agricultural chemicals has also damaged groundwater supplies. (Cassar-PTT)
W88-06879

DISSOLVED ORGANIC CARBON IN STREAMS AND GROUNDWATER,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W88-06902

NITRATE DEPLETION IN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM,
York Univ., Toronto (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W88-06919

INFLUENCE OF INORGANIC AND ORGANIC NUTRIENTS ON AEROBIC BIODEGRADATION AND ON THE ADAPTATION RESPONSE OF SUBSURFACE MICROBIAL COMMUNITIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W88-07003

DECAY OF DISSOLVED SUBSTANCES BY SECOND-ORDER REACTION; PROBLEM DESCRIPTION AND BATCH-REACTOR SOLUTIONS,
U. S. Salinity Lab. Soil and Water Management Research Unit, Riverside, CA 92521.
For primary bibliographic entry see Field 5B.
W88-07073

ASSESSMENT OF RECHARGE COMPONENTS FOR A CHALK AQUIFER UNIT,
Birmingham Univ. (England). Dept. of Civil Engineering.
D. Jackson, and K. R. Rushton.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 1-15, June 30, 1987. 7 fig, 3 tab, 15 ref, append.

Descriptors: *Surface-groundwater relations, *Groundwater movement, *Recharge, *Groundwater recharge, *Soil water, Infiltration, Aquifer characteristics, Carbonate aquifers, Gipping River, England, Mathematical models, Model studies.

The recharge components were identified in a chalk catchment in the Gipping River area of England. The aquifer is partially overlain by boulder clay which is usually separated from the Chalk by a layer of sand or gravel. The major components were: (A) flow through boulder clay which is greater than 10 m thick which then enters the underlying sand and gravel layer; (B) runoff, interflow and lateral transfer within the sand and gravel deposits which flow into the high-transmissivity chalk at the margins of the boulder clay; (C) water originating from precipitation which flows from the soil zone directly to the chalk, and sand and gravel on the valley sides and in the central valley areas; and (D) river-groundwater interaction. The relative magnitudes of the recharge components were computed. Component A provides the major part of total recharge during the summer months. Component B shows greater variation between winter and summer, but never falls below 8 Ml/day. Component C varies from almost zero to providing as much as 50% of recharge during heavy winter rain. Component D shows small fluctuations, occasionally flowing from the river to the aquifer. Field evidence and mathematical models were used in this study. (Cassar-PTT)
W88-07105

ANALYSIS OF AN ANISOTROPIC COASTAL AQUIFER SYSTEM USING VARIABLE-DENSITY FLOW AND SOLUTE TRANSPORT SIMULATION,
Geological Survey, Box 50166, Honolulu, HI 96850.
W. R. Souza, and C. I. Voss.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 17-41, June 30, 1987. 13 fig, 3 tab, 43 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Coastal aquifers, *Anisotropy, *Solute transport, *Saline water intrusion, Model studies, Oahu, Hawaii, Aquifer characteristics, Hydraulic conductivity, Water storage, Geohydrology, Specific yield.

The groundwater system in southern Oahu, Hawaii, consists of a thick areally extensive freshwater lens overlying a zone of transition to a thick saltwater body. This system was analyzed in cross section with a variable-density groundwater flow and solute transport model on a regional scale. The simulation was difficult because the coastal aquifer system has a saltwater transition zone that is broadly dispersed near the discharge area but is very sharply defined inland. Steady-state simulation of the transition zone in the layered basalt aquifer of southern Oahu indicated that a small transverse dispersivity is characteristic of horizontal regional flow. Further, in this system, flow is generally parallel to isochlors, and steady-state behavior is insensitive to the longitudinal dispersivity. Parameter analysis identified that only six parameters control the complex hydraulics of the system: horizontal and vertical hydraulic conductivity of the basalt aquifer; hydraulic conductivity of the confining caprock layer; leakance below the caprock; specific yield; and aquifer matrix compressibility. The best-fitting models indicated that the horizontal hydraulic conductivity is significantly greater than the vertical hydraulic conductivity. These models gave values for specific yield and aquifer compressibility which imply a considerable degree of compressive storage in the water table aquifer. (Author's abstract)
W88-07106

NON-DARCIAN FLOW IN FRACTURED ROCKS WITH A LINEAR FLOW PATTERN,
Department of Hydraulics, Civil Engineering Faculty, Technical University of Istanbul, Ayazaga, Istanbul, Turkey.
Z. Sen.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 43-57, June 30, 1987. 6 fig, 1 tab, 18 ref.

Descriptors: *Groundwater movement, *Karst hydrology, *Geologic fractures, *Aquifer characteristics, Geohydrology, Forcheimer Law, Darcys law, Wells, Turbulent flow, Linear flow.

Groundwater flow through fractured rocks deviates from the classical Darcian solutions. The occurrence of linear flow towards extensive or medium length dipping geological structures such as faults, joints, contact surfaces, and fractures is common, especially in igneous and metamorphic rocks. Wells drilled in these structures have permeabilities much greater than the host rock. As a result of the interconnecting faults and joints, flow lines become parallel, and water abstraction becomes easier. However, the secondary flow in the fissures violates Darcian law because the type of flow becomes turbulent, especially at high velocities. This paper presents an analytical solution to account for the turbulent flow using the Forchheimer law. Curves are presented to help practicing hydrogeologists to determine the aquifer parameters by a type curve matching procedure. Graphs compare Darcian and non-Darcian flows in fractured media. The methodology was applied to the Madera formation of Pennsylvanian age. The aquifer test had an average discharge of 97 gal/min and an aquifer thickness of 243 ft. Storativity and transmissivity properties were calculated from data obtained from two observation wells. (Cassar-PTT)
W88-07107

NUMERICAL MODEL FOR THE FORMATION OF SALINE WATERS DUE TO DIFFUSION OF DISSOLVED NA CL IN SUBSIDING SEDIMENTARY BASINS WITH EVAPORITES,
Louisiana State Univ., Baton Rouge. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W88-07110

MODEL STUDY OF SOME FACTORS INFLUENCING THE RESATURATION OF SPOIL FOLLOWING MINING AND RECLAMATION,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 4C.
W88-07111

MICROSCALE CHEMICAL HETEROGENEITY IN GROUNDWATER,
Isotope Department, The Weizmann Institute of Science, 7100 Rehovot, Israel.
For primary bibliographic entry see Field 5B.
W88-07113

VARIABILITY OF SATURATED HYDRAULIC CONDUCTIVITY IN A GLOSSAQUIC HAPLUDALF WITH MACROPORES,
Agricultural Univ., Wageningen (Netherlands).
J. G. Louren, R. J. Wagenet, J. Bouma, and J. H. M. Wosten.
Soil Science SOSCAK, Vol. 145, No. 1, p 20-28, January 1988. 6 fig, 5 tab, 24 ref.

Descriptors: *Soil water, *Saturated flow, *Permeability coefficient, *Groundwater movement, *Clays, *Pore size, Spatial distribution, Soil surfaces, Void space, Density, Soil physical properties, Soil types, Sand, Silt, Sampling, Analysis of variance, Correlation analysis, Statistical analysis.

The spatial variability of saturated hydraulic conductivity (K sub sat) was measured in situ in a clayey soil with macropores. K sub sat was determined at 37 equally-spaced transect sampling locations using five different-sized, in situ soil columns. Each column, starting with the largest, was constructed within the confines of the previous column. Excavation of a block of soil on four sides, with the block remaining naturally attached at the bottom, defined a volume of soil to be used in K sub sat determination. The volumes used were 240,000, 120,000, 50,000, 6280, and 884 cc. Quantitative estimates of macroporosity were obtained from tracings of visible tubular and planar voids at the exposed upper soil surface. Measurement was also made of bulk density and percentage sand, silt, and clay. The mean and variance of K sub sat were found to be a function of the sample volume used, with the two smallest volumes producing estimated moments much larger than observed using the next two largest sizes. The 240,000-cc-volume sample size proved to be an operationally cumbersome method and also produced extreme and probably unreliable estimates of mean and variance. Geostatistical analysis demonstrated spatial structure to exist for the 120,000 and 50,000-cc sample volumes, but only random variation was observed for the other three sizes. Cross-correlation between K sub sat and macrovoids and K sub sat and physical properties was also demonstrated. These results suggest that the macrovoid area or percentages of silt or clay could be used to predict the spatial distribution of K sub sat in the field. (Author's abstract)
W88-07171

OCCURRENCE AND CHEMISTRY OF HIGH FLUORIDE GROUNDWATERS IN JALORE DISTRICT OF WESTERN RAJASTHAN.
Ground Water Department, Jodhpur 342003, India.
For primary bibliographic entry see Field 5B.
W88-07187

SIMPLE METHOD TO ESTIMATE SPECIFIC EQUILIBRIUM SOIL-WATER CONTENT IN A UNIFORM SOIL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2G.
W88-07189

FINITE-ELEMENT SIMULATION OF LOW-TEMPERATURE, HEAT-PUMP-COUPLED, AQUIFER THERMAL ENERGY STORAGE,
Kent State Univ., OH. Dept. of Geology.
T. E. Dwyer, and Y. Eckstein.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 19-38, 15 November 1987. 9 fig, 5 tab, 56 ref.

Descriptors: *Groundwater storage, *Aquifers, *Heated water, *Thermal capacity, *Simulation analysis, *Mathematical models, *Finite element method, Feasibility studies, Sensitivity analysis, Confined aquifers, Aquitards, Geologic formations, Injection, Pumping, Ohio.

A two-dimensional, Galerkin finite-element transport model was applied to a feasibility study of low temperature, heat pump coupled, aquifer thermal energy storage in a confined sandstone aquifer in northeastern Ohio. Simulations were run to determine the relative sensitivity of the model to transient versus steady-state radial flow, grid size, time-step lengths, and injection temperatures. In order to determine the effects of uncertainties in the values of aquifer and aquitard parameters, energy recovery factors and recovery temperatures were calculated for worst-case, best-case, and best-estimate simulations. All simulations were performed assuming a 150 d injection phase, a 35 d storage phase, a 150 d production phase, and a pumping rate of 15 cu m/h. The worst-case simulation for an injection temperature of 23.9 C produced an energy recovery factor of 0.43 and a final production temperature of 14.6 C. The best-case simulation resulted in an energy recovery factor of 0.69 and a final production temperature of 16.2 C. The best-estimate simulation predicted an energy recovery factor of 0.50 and a final production temperature of 15.0 C. Both the energy recovery factor and the recovery temperature were most affected by the uncertainty in the storage formation longitudinal dispersivity. Using the best-estimate parameter values, an injection temperature of 18.0 C resulted in a final production temperature of 13.2 C and an energy recovery factor of 0.50. The best-estimate parameter values used with an injection temperature of 27.0 C yielded a final production temperature of 15.9 C and an energy recovery factor of 0.50. (Author's abstract)
W88-07190

HYDROGEOLOGY, HYDROCHEMISTRY, AND ENVIRONMENTAL ISOTOPES OF THE CAMPASPE RIVER AQUIFER SYSTEM, NORTH-CENTRAL VICTORIA, AUSTRALIA,
Geological Survey of Israel, Jerusalem.
A. Arad, and R. Evans.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 63-86, 15 November 1987. 10 fig, 3 tab, 15 ref.

Descriptors: *Aquifer systems, *Australia, *Geohydrology, *Chemical properties, *Isotope tracers, *Irrigation-return flow, *Palth of pollutants, Geologic units, Aquitards, Natural recharge, Salinity, Dissolved solids, Leaky aquifers, Hydrological regime, Irrigation.

The Campaspe River hydrogeological system of North-Central Victoria, Australia consists of two major units: (1) the Deep Lead aquifer, which forms the major aquifer of the region; and (2) the Shepparton Formation, which forms a complex aquitard-aquifer system on top of the Deep Lead. Recharge to the Deep Lead aquifer is twofold: (1) a major component of recharge occurs along the southern reaches of the Campaspe River where the overlying Shepparton Formation is thin and becomes more permeable; and (2) recharge occurs by vertical downward movement of water from the Shepparton Formation. Natural discharge from the system occurs further to the northwest beyond the Murray River. Salinity gradually increases downgradient in the Deep Lead, with an abrupt increase to greater than 6000 mg/l total dissolved solids close to the Murray River, except in the Goornong area in the south, which appears to be separated from the main Deep Lead system. The Shepparton Formation waters on the other hand, are characterized by disorder, namely, fresh to saline water juxtaposed both horizontally and vertically. Heads in both the Shepparton Formation and the Deep Lead had been increasing at the rate of about 15-20 cm/yr, for at least several decades. The advent of large-scale withdrawal from the Deep Lead in the early 1980s has arrested this trend. In the northern and central portions of the area, a decline in aquifer pressures is evident. This decline will induce increased leakage from the Shepparton Formation down into the deeper aquifer, and such leakage could possibly result in a degradation of water quality. Stable isotope data indicate that under the existing hydrologic regime little irrigation drainage water has penetrated to the deep system. (Author's abstract)
W88-07193

ELLIPTICAL INHOMOGENEITIES IN GROUNDWATER FLOW: AN ANALYTICAL DESCRIPTION,
National Institute of Public Health and Environmental Hygiene (RIVM), P.O. Box 1, 3720 MA Bilthoven, The Netherlands.
A. N. M. Obdam, and E. J. M. Veling.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 87-96, 15 November 1987. 5 fig, 7 ref.

Descriptors: *Mathematical models, *Groundwater movement, *Heterogeneity, *Reconnaissance studies, Numerical analysis, Simulation analysis, Porous media, Permeability, Uniform flow, Flow rates, Homogeneity, Geohydrology, Field tests.

In the ideal case, the porous medium to be described by a numerical groundwater simulation model can be divided into representative elementary volumes. In these volumes, the mean geohydrological parameters are acquired by using averaging methods to the individual measurements of these parameters. However, in practice many disturbances of this ideal picture occur, especially in the form of discontinuities in the so-called homogeneous porous medium. In order to be able to decide whether and how heterogeneities should be taken into account for modelling a groundwater flow problem, the magnitude of those disturbances must be estimated. Therefore, in this paper the authors solve the problem of a uniform flow in a homogeneous medium with an elliptically-shaped inhomogeneity with a different value for the permeability and positioned under an arbitrary angle with respect to the undisturbed flow. A simple analytical expression is derived for the ratio of groundwater quantities flowing through and along an inhomogeneity. The ratio of the flow rate through this body is calculated with respect to the undisturbed case. Besides its use in solving groundwater flow problems, this formula may be helpful for problems relevant to field reconnaissance. (Author's abstract)
W88-07194

REPRESENTATION OF FLOWS TO PARTIALLY PENETRATING RIVERS FROM LAYERED AND ANISOTROPIC AQUIFERS,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
J. C. Miles.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 113-129, 15 November 1987. 14 fig, 3 tab, 11 ref.

Descriptors: *Surface-groundwater relations, *Mathematical equations, *Seepage, *Rivers, *Buried rivers, *Aquifers, *Anisotropy, *Groundwater movement, *Mathematical models, Dupuit-Forcheimer theory, Herbert formula, Homogeneity, Isotropy, Porous media, Irrigation, Drains.

It has previously been shown that it is possible to represent the flow of water from a homogeneous, isotropic aquifer to a river or drain by using a Dupuit-Forcheimer groundwater flow model coupled with equations to calculate the magnitude of the flow to the river. Of the methods suggested as being suitable for calculating the flow of water to a partially penetrating river from a Dupuit-Forcheimer-based groundwater flow model of a homogeneous isotropic aquifer only the formula of Herbert has been found to be capable of representing such flows in anisotropic and layered aquifers. A method of calculating the parameters in the equation of Herbert to enable it to cope with anisotropic and layered aquifers has been derived using fundamental principles of the flow of a liquid in a porous medium. Results obtained from two-dimensional free surface seepage models are used to assess the accuracy of the results from the Dupuit-Forcheimer models. It is shown that such models can be used to accurately estimate the flow to a river for a wide variety of situations; the work is also applicable to irrigation systems. (Author's abstract)
W88-07196

LINEAR GRAPHICAL METHOD FOR DETERMINING HYDRODISPERSIVE CHARACTERISTICS IN TRACER EXPERIMENTS WITH INSTANTANEOUS INJECTION,
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
For primary bibliographic entry see Field 5B.
W88-07198

PREDICTING GROUNDWATER FLOW IN A PHREATIC AQUIFER,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
S. E. Serrano, and T. E. Unny.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 241-268, 30 November 1987. 9 fig, 2 tab, 52 ref, append.

Descriptors: *Groundwater movement, *Prediction, *Mathematical models, *Groundwater, *Aquifers, Forecasting, Environmental effects, Errors, Statistical methods, Groundwater potential, Stochastic hydrology, Boussinesq equation, Laplace equation, Boundary conditions, Free surfaces, Canada, Mathematical equations.

An innovative approach to the solution of groundwater forecasting problems using mathematical models is presented. The approach specifically accounts for the errors generated in the development and solution of the groundwater flow equations, and the uncertainty generated by the use of data subject to environmental fluctuations and measurement errors. Since both the input data and the model are subject to considerable uncertainty, the groundwater heads simulated by a mathematical model should be presented in a statistical sense. Validation of a mathematical model should be assessed by the ability of the model to reproduce the statistical properties of the field measurements. This article describes in detail the development, solution and validation of two mathematical models describing groundwater potential at the Twin Lake aquifer, Chalk River, Ontario, Canada. The first one results from the application and solution of the stochastic Boussinesq equation with Dupuit assumptions. The second one results from the boundary elements solution of the two-dimensional Laplace equation with a stochastic free surface boundary condition. (Author's abstract)
W88-07204

WATER TABLE RISE IN A SEMICONFINED AQUIFER DUE TO SURFACE INFILTRATION AND CANAL RECHARGE,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-07205

TYPE CURVES IN PATCHY AQUIFERS,
Department of Hydraulics, Civil Engineering Faculty, Technical University of Istanbul, Ayazaga, Istanbul, Turkey.
Z. Sen.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 277-287, 30 November 1987. 3 fig, 10 ref.

Descriptors: *Groundwater movement, *Drawdown, *Mathematical analysis, *Pumping tests, *Unconsolidated aquifers, Differential equations, Continuity equation, Darcys law, Boltzmann transformation, Laplace equation, Theis equation, Jacob method, Hydraulic properties, Well hydraulics, Mathematical equations.

Simple analytical type curve equations were derived for pumping test analysis in a patchy aquifer. A patchy aquifer has different hydraulic parameters in the vicinity of the well. Any aquifer with a certain domain around the well with different hydraulic properties than the remaining parts can be considered as a patchy aquifer. The basis of the methodology developed herein is to combine mathematically the continuity and the Darcy laws in the forms of simultaneous partial differential equations. The solution is obtained through the use of the Boltzmann transformation which renders the partial differential equations into the ordinary counterparts that can be solved without recourse to Laplace transformations. The region of the aquifer in which the pumping well exists has very special type curves and the applications of neither the Theis nor the Jacob straight-line methods are possible except in a few restrictive cases. However, in the second region the Theis method is applicable for a number of special combinations of parameters and the Jacob method is always applicable, but for longtimes only. (Author's abstract)
W88-07206

OPTIMAL GROUNDWATER MANAGEMENT IN TWO-AQUIFER SYSTEMS,
Erftverband, Paffendorfer Weg 42, D-5010 Bergheim FRG.
For primary bibliographic entry see Field 4B.
W88-07274

GROUND WATER QUALITY PREDICTION USING CLIMATIC INDICES,
North Texas State Univ., Denton. Dept. of Geography.
For primary bibliographic entry see Field 2K.
W88-07276

NUMERICAL MODELING OF SOLUTE TRANSPORT PATTERNS IN THE DAMMAM AQUIFER,
Civil Engineering Department, King Fahd University of Petroleum and Minerals, Dhaharan, Saudi Arabia.
For primary bibliographic entry see Field 5B.
W88-07280

EFFECTS OF NO-FLOW RIVER CONDITIONS ON THE PLATTE RIVER WELL FIELD,
Broward County Water Resources Management Division, 115 South Andrews Ave., Room 324, Fort Lauderdale, Florida 33301.
For primary bibliographic entry see Field 5B.
W88-07283

GENERATION AND QUALITY OF STREAMFLOW ON INACTIVE URANIUM TAILINGS NEAR ELLIOT LAKE, ONTARIO,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
D. W. Blowes, and R. W. Gillham.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 1-22, January 15, 1988. 17 fig, 2 tab, 21 ref. NSERC Grant No. A6414.

Descriptors: *Rainfall-runoff relationships, *Water pollution sources, *Water chemistry, *Runoff rates, *Surface-groundwater relations, *Uranium, *Path of pollutants, *Groundwater movement, *Mine wastes, Surface water, Discharge Hydrographs, Shallow water, Groundwater, Storm runoff, Capillary water, Capillary zone, Water table rise, Geohydrology, Physical properties, Streamflow, Geochemistry, Oregon.

A study was undertaken to investigate the physical and chemical interactions between groundwater and surface water in an area of inactive uranium mill tailings near Elliot Lake, Ontario. The study area had a shallow water table and was drained by a single channel. Streamflow chemistry and discharge and the hydraulic response of the groundwater system were monitored for several runoff events during the period of September 1981 through May 1982. The hydrographs measured for each event were separated into groundwater and surface-water components using the mass-balance technique with Cl(-) and O18 as conservative tracers. The mechanisms of streamflow generation and their effect on runoff quality were evaluated on the basis of the hydrograph separations, the observed groundwater response, and the characteristics of the precipitation events. The results indicate that groundwater constitutes a significant amount of the stormflow generated in the study area. The magnitude of this contribution was dependent upon the intensity and duration of rainfall and on the initial depth to the water table. The capillary fringe played an important role in the processes of streamflow generation, both in causing a large water-table rise which increased groundwater flow to the stream, and in forming an expanding seepage face which enhanced overland flow. During runoff events the stream contained high concentrations of several dissolved inorganic species. The groundwater contribution was a major source of these constituents. The findings of this study indicate that groundwater can be a major component of streamflow during runoff events in inactive tailings areas, and as a result, can have a major influence on runoff quality. The groundwater contribution to streamflow represents an important pathway of contamination migration to the biosphere which can be anticipated to persist for long periods of time. (Author's abstract)
W88-07294

FIELD INVESTIGATIONS OF THE NATURE OF WATER-TABLE RESPONSE TO PRECIPITATION IN SHALLOW WATER-TABLE ENVIRONMENTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2B.
W88-07295

ESTIMATES OF SPECIFIC YIELD WITH THE GEOELECTRIC RESISTIVITY METHOD IN GLACIAL AQUIFERS,
Rhode Island Univ., Kingston. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W88-07296

EFFECT OF MONITORING WELL STORAGE ON THE SHAPE OF BREAKTHROUGH CURVES - A THOEORETICAL STUDY,
Department of Environmental Sciences, Oregon Graduate Center, 19600 NW von Neumann Drive, Beaverton, OR 97006-1999.
For primary bibliographic entry see Field 7C.
W88-07297

HYDROCHEMISTRY OF GROUNDWATER AT UNIQUE OUTLETS OF THE BET SHEAN-HAROD MULTIPLE-AQUIFER SYSTEM, ISRAEL,
Research Division, Hydrological Service of Israel, P.O. Box 6381, Jerusalem 91063.
For primary bibliographic entry see Field 2K.
W88-07299

CA-CHLORIDE BRINES AT COMMON OUTLETS OF THE BET SHEAN-HAROD MULTIPLE-AQUIFER SYSTEM, ISRAEL,
Research Division, Hydrological Service of Israel, P.O. Box 6381, Jerusalem 91063 (Israel).
E. Rosenthal.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 89-106, January 15, 1988. 2 fig, 3 tab, 43 ref.

Descriptors: *Aquifer characteristics, *Geochemistry, *Water quality, *Geohydrology, *Groundwater movement, *Mixing zones, *Brines, Outlets, Geology, Multiple-aquifer systems, Basalts, Carbonates, Paleohydrology, Israel.

The Bet Shean and Harod Valleys are regional recipients and mixing zones for groundwaters draining into them from a multiple-aquifer system, which includes carbonate and basalt aquifers and deep-seated reservoirs of brine. The outlets of the three aquifers are located at the mountain border separating the valleys from the Bilboa and Ramot Issakhar Mountains. The aquifers drain through two types of outlets, unique and common. Upon reaching the interconnecting zones, fresh groundwaters flowing from carbonate and basalt aquifers intermix, losing their hydrochemical identities. Ca-chloride brines originating from deep-seated and confined reservoirs, leak along the deep-seated faults characterizing the common outlet zones and contaminate the relatively fresh mixing products originating from the three regional aquifers. Two types of dilute Ca-chloride brines were identified in the study area. The Devora type is a hot and hypersaline source brine which was identified at great depth and under very high hydrostatic pressures. This brine could be the residual product of seawater that evaporated during the Cambrian-Cretaceous continental interval and subsequent prolonged interaction with surrounding carbonate rocks. The Neve Ur-type brine seems to be genetically related to the Neognee inland Sdom Sea that preceeded the contemporary Dead Sea. (See W88-07299 and W88-07301) (Friedmann-PTT)
W88-07300

HYDROCHEMICAL CHANGES INDUCED BY OVEREXPLOITATION OF GROUNDWATER AT COMMON OUTLETS OF THE BET SHEAN-HAROD MULTIPLE-AQUIFER SYSTEM, ISRAEL,
Research Division, Hydrological Service of Israel, P.O. Box 6381, Jerusalem 91063 (Israel).
E. Rosenthal.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 107-128, January 15, 1988. 6 fig, 4 tab, 18 ref.

Descriptors: *Aquifer characteristics, *Geochemistry, *Water quality, *Geohydrology, *Groundwater movement, *Saline water, *Mixing zones, *Water chemistry, *Brines, Outlets, Geology, Geologic faults, Multiple-aquifer systems, Reservoirs, Calcium chloride, Israel, Chemical properties.

The Bet Shean and Harod Valleys are regional recipients and mixing zones for groundwaters draining into them from a multiple-aquifer system which includes carbonate and basalt aquifers and deep-seated reservoirs of brine. The aquifers drain through two types of outlets, unique and common. The latter type is mainly conditioned by the occurrence of fault blocks acting as connecting media between the aquifers. Ca-chloride brines originating from deep-seated and confined reservoirs, leak along the major faults and contaminate the relatively fresh groundwaters originating from the regional aquifers. During the last two decades, the salinity of groundwaters at the outlets of aquifers and in springs discharging into the valleys, have increased as the result of overexploitation. The changes in the chemical composition of these waters indicated inflow of dilute Ca-chloride brines which replace at an ever increasing rate the fresh water of the area. The inflow of brines is limited to fault zones and seems to be controlled by the counterpressure of the overlying fresh water. Overexploitation diminishes this counterpressure, thus facilitating the progressive upflow of brines. (See W88-07299 thru W88-07300) (Author's abstract)
W88-07301

FORECAST OF CHANGES IN PIEZOMETRIC LEVELS BY A LUMPED HYDROLOGICAL MODEL,
Water and Environmental Department, Bureau of Geological and Mining Researches, Avenue de Concyr, B.P. 6009, 45060 Orleans Cedex 2 (France).
D. Thiery.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 129-148, January 15, 1988. 8 fig, 5 tab, 8 ref.

Descriptors: *Model studies, *Simulation analysis, *Recharge, *Infiltration, *Hydrologic models, *Aquifers, *Groundwater recharge, *Water level, Piezometers, Simulation, Carbonate aquifers, Prediction.

A lumped parameter hydrological model for the simulation of the levels of an unconfined aquifer influenced by variations of recharge from rainfall has been applied to thirteen independent observation wells in the chalk aquifer in Picardie (France). The model was modified by an updating procedure taking into account the observed discrepancies, to be used in long-term forecasting. The model generally allows correct simulation of the variation in level at a point of an unconfined aquifer subject to recharge variations by rainfall. However, as the example shows, the model can only be calibrated reliably over a long observation period. A forecast was performed using possible scenarios of rainfall during the following months with variable results. For 5 of the 13 piezometers the standard deviation of error was halved by the updating procedure. It is necessary to consider several possible future rainfall scenarios to make forecasts that are graduated in probability. (Friedmann-PTT)
W88-07302

FIELD STUDY OF SEEPAGE AND MIGRATION PROCESSES IN FISSURED-POROUS ROCKS,
Department of Hydrogeology, Mining Institute, 22-linga Leningrad V.O. (U.S.S.R.).
For primary bibliographic entry see Field 5B.
W88-07303

ESTIMATION OF SPATIAL RECHARGE DISTRIBUTION USING ENVIRONMENTAL ISOTOPES AND HYDROCHEMICAL DATA I. MATHEMATICAL MODEL AND APPLICATION TO SYNTHETIC DATA,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
E. M. Adar, S. P. Neuman, and D. A. Woolhiser.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 251-277, February 15, 1988. 6 fig, 7 tab, 71 ref, 3 append. U.S. Dept. of Interior Contract No. A-099-ARIZ.

Descriptors: *Recharge, *Tracers, *Model studies, *Aquifers, *Mathematical models, *Groundwater recharge, *Spatial distribution, Isotopes, Water chemistry, Environmental tracers.

A mathematical model is proposed to estimate the spatial distribution of annual recharge rates into an aquifer using environmental isotopes and hydrochemical data. The aquifer is divided into cells within which the isotopes and dissolved constituents are assumed to undergo complete mixing. For each mixing cell mass-balance equations expressing the conservation of water, isotopes and dissolved chemicals are written. These equations are solved simultaneously for unknown rates of recharge into the various cells by quadratic programming. The degree to which individual dissolved constituents may be considered conservative is tested a-priori by a chemical equilibrium model such as WATEQF. Constituents which do not pass this test are either disregarded or suitably assigned a small weight in the quadratic program. The model is applied to synthetic data corrupted by random noise and its sensitivity to input errors examined by a Monte Carlo approach. The noisy data were fed into the quadratic program to yieldl corresponding estimates of the unknown flow rates. A comparison of these computed flow rates with their known true values showed that the model works reasonably well as long as ionic balance is maintained between the dissolved constituents, the relation between 018 and deuterium is linear as expected from real data and the species are conservative. (See also W88-07311) (Friedmann-PTT)
W88-07310

ESTIMATION OF SPATIAL RECHARGE USING ENVIRONMENTAL ISOTOPES AND HYDROCHEMICAL DATA: II. APPLICATION TO ARAVAIPA VALLEY IN SOUTHERN ARIZONA, U.S.A.,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
E. M. Adar, and S. P. Neuman.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 279-302, February 15, 1988. 14 fig, 4 tab, 22 ref.

Descriptors: *Recharge, *Aquifers, *Confined aquifers, *Mathematical models, *Model studies, *Tracers, *Groundwater recharge, Isotopes, Water chemistry, Environmental tracers, Leakage, Arizona.

A mathematical model was developed to estimate the spatial distribution of annual recharge rates into an aquifer using environmental isotopes and hydrochemical data. The model was applied to real data from the Aravaipa Valley in southern Arizona. These data suffer from a paucity of hydrologic information but contain numerous isotopic and hydrochemical analyses. The model was able to extract from the available data both qualitative and quantitative information about recharge into, and flow through, the shallow unconfined aquifer in the valley. The model shows that this aquifer is replenished primarily by lateral recharge from the pediments and the tributary Stowe Gulch Basin, as well as by upward leakage from the underlying confined aquifer. Recharge from the Aravaipa Creek is relatively minor. Lateral recharge from the eastern pediments into the unconfined aquifer exceeds that from the western pediments by a factor of two. The western pediments are a major source of recharge for the confined aquifer. These results are tentative because independent means to verify them are currently lacking. The mass balance errors of water and dissolved constituents do not exceed 4%, and the flow rate obtained from Darcy's law at one location within the unconfined aquifer in which transmissivity is known, agrees with model prediction. While chemical reactions are ignored in the model, some of the isotopic and chemical species show sufficient spatial variability due to mixing to justify the approach. This is supported by analyses of equilibrium water-mineral interactions conducted by WATEQF. (See also W88-07310) (Author's abstract)
W88-07311

STATISTICAL POSSIBILITIES FOR PREDICTING HYDRAULIC PROPERTIES FROM GEOELECTRICAL PARAMETERS IN A STRONGLY HETEROGENEOUS AQUIFER, PLAIN OF HAOUZ, MOROCCO. (POSSIBILITES STATISTIQUES DE PREDICTION DES PROPRIETES AQUIFERES A L'AIDE DES PARAMETRES GEOELECTRIQUES EN MILIEU SEDIMENTAIRE FORTEMENT HETEROGENE, PLAINE DU HAOUZ, MAROC),
Hydrogeological Laboratory, Technical and Scientific University, 34060 Montpellier Cedex (France).
M. Razack, and M. Sinan.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 323-340, February 15, 1988. 10 fig, 5 tab, 36 ref, append.

Descriptors: *Transmissivity, *Aquifers, *Alluvial aquifers, *Transmissivity, *Resistivity, *Groundwater movement, *Hydraulic permeability, *Geoelectrical studies, Statistical analysis, Permeability.

The relationships between hydraulic (transmissivity, T) and geoelectrical (transverse resistance, TR) parameters in a strongly heterogeneous alluvial aquifer (Plain of Haouz, Morocco) were statistically analyzed. Samples of both parameters are large enough for this purpose. Several statistical regressions (linear, exponential, geometrical) of T or TR, together with several assumptions for the transverse resistance computation were tested. The best relationship was obtained when considering a geometrical regression of T on the TR of only the permeable beds. Additionally, when the values T sub i nd TR sub i of a given pair i, were corrected to the same water table elevation, the precision of the prediction of T was significantly increased. A quantitative and reliable relationship between the two parameters is proposed to predict, at less cost and with an acceptable accuracy, the transmissivity of the Haouz groundwater. (Author's abstract)
W88-07313

LABORATORY DETERMINATION OF DIFFUSION COEFFICIENTS OF CONTAMINANTS USING UNDISTURBED CLAYEY SOIL,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5B.
W88-07427

TILL BEHAVIOR AND ITS RELATIONSHIP TO ACTIVE-LAYER HYDROLOGY, DISTRICT OF KEEWATIN, NORTHWEST TERRITORIES,
Department of Geological Sciences, Queen's University, Kingston, Ont., Canada K7L 3N6.
For primary bibliographic entry see Field 8D.
W88-07428

BUOYANCY FLOW AT A TWO-FLUID INTERFACE IN A POROUS MEDIUM: ANALYTICAL STUDIES,
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 5B.
W88-07439

COMBINED FORCED-CONVECTION AND BUOYANCY FLOW AT A TWO-FLUID INTERFACE IN A POROUS MEDIUM: ANALYTICAL STUDIES,
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 5B.
W88-07440

PROCESSES AFFECTING THE DISTRIBUTION OF SELENIUM IN SHALLOW GROUNDWATER OF AGRICULTURAL AREAS, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA.
For primary bibliographic entry see Field 5B.

W88-07441

OPTIMAL DEWATERING SCHEMES IN THE FOUNDATION DESIGN OF AN ELECTRONUCLEAR PLANT,
ENEL-CRIS, Mestre-Venezia, Italy.
For primary bibliographic entry see Field 8A.
W88-07444

PSEUDOPOTENTIAL FUNCTIONS IN CONSTRUCTION OF FLOW NETS FOR CONTAMINANT TRANSPORT MODELING,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 5B.
W88-07445

EXPLANATION OF SCALE-DEPENDENT DISPERSIVITY IN HETEROGENEOUS AQUIFERS USING CONCEPTS OF FRACTAL GEOMETRY,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 5B.
W88-07447

ANALYTICAL SOLUTION INCORPORATING NONLINEAR RADIAL FLOW IN CONFINED AQUIFERS,
Hydraulics Div., Civil Engineering Faculty, Istanbul Technical Univ., Ayazaga, Istanbul, Turkey.
Z. Sen.
Water Resources Research WRERAO, Vol. 24, No. 4, p 601-606, April 1988. 3 fig, 34 ref, append.

Descriptors: *Radial flow, *Confined aquifers, *Type curves, *Groundwater movement, *Mathematical studies, Calibrations, Equations, Flow, Aquifers, Groundwater.

Type curve expressions were derived for the nonlinear flow in confined aquifers on the basis of Forchheimer flow law which presents a combination of the laminar and turbulent flows of the groundwater. Solutions of the relevant initial boundary value problem were achieved by the application of the Boltzmann transformation that permits the coupling of the continuity equation and Forchheimer's law. The validity of the results were checked against the well-known Theis and Jacob equations which are only applicable to linear (Darcian) flow. Necessary type curves matching of all times and a straight line method for large times are proposed to evaluate the aquifer parameters with aquifer tests conducted in nonlinear flow conditions. An example application of the proposed methodology is given for aquifer test results in Nova Scotia, Canada. (Author's abstract)
W88-07450

TRANSFER FUNCTION MODEL FOR THE PREDICTION OF NITRATE LEACHING UNDER FIELD CONDITIONS,
Oxford Univ. (England). Dept. of Plant Sciences.
For primary bibliographic entry see Field 5B.
W88-07511

SIMULATION OF WATER DISCHARGE RATES FROM A CLAY-TILL SOIL OVER A TEN YEAR PERIOD,
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
For primary bibliographic entry see Field 2G.
W88-07514

NEGATIVE PHASE SHIFT OF GROUNDWATER TIDES NEAR SHALLOW TIDAL RIVERS - THE GOUDERAK ANOMALY,
Research Department, The netherlands Waterworks Testing and Research Institute KIWA Ltd., P.O. Box 1072, 3430 BB Nieuwegein (The Netherlands).
For primary bibliographic entry see Field 2E.
W88-07519

HYDROGEOLOGY OF THE AMADEUS BASIN, CENTRAL AUSTRALIA,
Birmingham Univ. (England). Dept. of Chemistry.
J. W. Lloyd, and G. Jacobson.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 1-24, August 15, 1987. 13 fig, 1 tab, 10 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Aquifers, *Hydrocarbons, *Groundwater basins, Amadeus Basin, Australia, Groundwater, Basins, Paleozoic strata, Sandstones.

Two hydrogeological environments are defined in the major sedimentary semi-arid Amadeus Basin (155,000 sq km) of Central Australia. The environments are structurally controlled and occur in Paleozoic strata. In the north-central part of the basin an area of broad wavelength folds contains extensive identifiable sandstone aquifers. Elsewhere strong folding and faulting has resulted in the development of a regional fractured rock aquifer. Because of the combination of lithological and structural control the two hydrogeological environments are only locally connected. Within the north-central area three aquifers have been defined with groundwater flows eastwards into the fractured aquifer. Erosion and facies changes result in hydraulic continuity occurring between the three aquifers close to their junction with the fractured aquifer. Over-pressured groundwater is present in the lowest of the three aquifers beneath hydrocarbons in two major structures adjacent to normally pressured groundwater. (Author's abstract)
W88-07522

LEAST-SQUARES ESTIMATION OF EQUATION PARAMETERS FOR PREDICTING DRAWDOWN FROM A SINGLE PUMPED WELL,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley, and A. D. Sneyd.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 153-161, August 15, 1987. 4 fig, 1 tab, 4 ref.

Descriptors: *Drawdown, *Aquifers, *Least-squares method, *Mathematical equations, *Groundwater level, *Pump wells, *Well hydraulics, Well data, Wells, Theis equation, Water resources studies.

The ability to predict drawdown magnitudes in a given pumped well is a necessary requirement in many water resource studies. Such predictions cannot always be achieved using the Theis equation, which is an approximate expression derived with respect to an infinitely thin well. The exact drawdown equation requires specification of the diameter of the pumped well in the confined aquifer. However, a reassignment of parameters permits the drawdown to be expressed as a function of transmissivity and beta, where beta is a lumped parameter combining well diameter and storativity. This approach is helpful since well diameter is seldom known exactlyf and there may be no observation well available to provide an estimate of storativity. Using this new set of parameters, a general least-squares procedure is presented for the estimation of transmissivity and beta. The method requires only a drawdown data set from the pumped well concerned. (Author's abstract)
W88-07531

IDENTIFICATION OF PARAMETERS IN SEMICONFINED AQUIFERS,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
K. Sridharan, R. Ramaswamy, and N. S. Lakshmana Rao.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 163-173, August 15, 1987. 6 fig, 11 ref.

Descriptors: *Aquifers, *Aquitards, *Confined aquifers, *Drawdown, *Groundwater level, *Pumping tests, *Mathematical studies, Storage, Least-squares method, Leakage, Transmissivity.

A method is presented for identification of parameters from pumping tests, in semiconfined aquifers with storage release from the aquitard. Four parameters were evaluated: the transmissivity of the aquifer; the storage coefficient of the aquifer; the leakage coefficient of the aquitard; and the storage coefficient of the aquitard. The Neuman and Witherspoon solution for the drawdown, valid for all time intervals, was used; this solution is not amenable to graphical procedures. The optimization problem was solved by sensitivity analysis technique. The method has the merit of utilizing field data for all times without classifying them into small and large time intervals. A computational procedure for evaluating the drawdown integral is presented. Two examples demonstrate the application of the method. (Author's abstract)
W88-07532

SOURCE OF SEEPAGE IN THE SUDAMDIH MINE AREA USING ENVIRONMENTAL ISOTOPES, BIHAR, INDIA,
National Geophysical Research Inst., Hyderabad (India).
B. S. Sukhija, D. V. Reddy, and S. K. Bhattacharya.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 191-197, August 15, 1987. 2 fig, 1 tab, 5 ref.

Descriptors: *Groundwater movement, *Tracers, *Subsurface ponds, *Ponds, *Seepage, *Mine drainage, *Coal mining, *Isotopes tracers, Oxygen isotopes, Tritium, Mining hydrology, Rivers, Damodar River, India.

The Sudamdih mine area situated in the Jharia coal fields of Bihar, India, has several old workings that have been abandoned due to waterlogging. During the development of several horizons in recent years heavy seepage of water was noted. An attempt has been made to find out the hydraulic link of the seepage water with one or more of the nearby water bodies, i.e. the Damodar River, a surface pond, groundwater etc. Preliminary study based on environmental isotopes, of tritium and oxygen-18, shows that most of the seepage water is probably derived from local groundwater. (Author's abstract)
W88-07534

ARTIFICIAL RECHARGE OF GROUND WATER,
Delft University of Technology, Division of Sanitary Engineering and Water Management, Delft, The Netherlands.
For primary bibliographic entry see Field 4B.
W88-07558

SURFACE GEOELECTRICS FOR GROUNDWATER POLLUTION AND PROTECTION STUDIES,
Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia).
For primary bibliographic entry see Field 7B.
W88-07564

EFFECTS OF FOREST CLEARING ON GROUNDWATER,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07570

DISTRIBUTION OF ENVIRONMENTAL CHLORIDE IN RELATION TO SUBSURFACE HYDROLOGY,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
C. D. Johnson.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 67-88, October 15, 1987. 8 fig, 5 tab, 32 ref.

Descriptors: *Geohydrology, *Groundwater quality, *Geochemistry, *Soil water, *Chlorides, *Subsurface water, *Salinity, *Recharge, *Groundwater movement, Flow, Chemical properties, Groundwater, Soil types, Model studies, Western Australia.

Chloride distributions in 32 deeply weathered profiles up to 39 m deep were used to investigate the

subsurface hydrology typical of the saline landscapes of the south-west of Western Australia. Studies took place in two forested areas of differing rainfall and landform to compare the processes of water movement. A steady-state model of water and chloride movement which included the effects of diffusion was used to estimate vertical soil water flux density from observed concentrations of chloride. These patterns of water flow were compared to the physical properties of the profiles. A great deal of variability was found between profiles and there was a marked difference in the magnitude of soil water flux density between the areas of different rainfall. However, consistent patterns of subsurface water movement can be identified. Thin coarse-textured surface soils are well-leached by rainfall but in the clayey unsaturated zone below, vertical soil-water flux densities are very small due to the uptake of water by the eucalyptus forest. Where rainfall was 800 mm/yr, soil water flux density was typically of the order 0.4 mm per year and in the area of 1150 mm per year rainfall, soil water flux density was 2-5 mm per year. Rates of recharge to groundwater estimated from chloride concentration in the saturated zone were as much as two orders of magnitude greater than soil water flux density above the water table. The preferred flow paths are distributed throughout the landscape but only constitute a small proportion of it. (Author's abstract)
W88-07571

ENVIRONMENTAL ISOTOPE HYDROLOGY OF SALINIZED EXPERIMENTAL CATCHMENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07572

PREFERRED WATER FLOW AND LOCALIZED RECHARGE IN A VARIABLE REGOLITH,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
C. D. Johnson.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 129-142, October 15, 1987. 6 fig, 1 tab, 19 ref.

Descriptors: *Groundwater movement, *Groundwater recharge, *Saline water, *Soil water, *Regoliths, *Soil types, Flow, Recharge, Piezometers, Rainfall, Salinity, Chlorides.

The mechanisms of water flow and recharge to groundwater were investigated in a deep clayey regolith in southwest Western Australia. A 700 sq m area was intensively studied for a period of two years. Vertical distributions of natural chloride in thirteen profiles up to 31 m deep were used to estimate the distribution of vertical soil-water flux density in the 16 m unsaturated zone and rates of recharge to groundwater. Groundwater dynamics were monitored using ten single and four multilevel piezometers. The regolith showed marked heterogeneity over horizontal and vertical distances of only a few meters. This resulted in complex patterns of water and solute movement through the profiles. Over most of the experimental area, vertical water flux density below 5 m in the unsaturated zone was from 2.2 to 7.2 mm/yr. However, within a relatively small portion of the site, vertical soil-water flux density was 50-100 mm/yr throughout the unsaturated zone. This flux more closely matched the apparent rate of recharge to groundwater. The area of preferred flow is apparently due to a discontinuity within the regolith. A groundwater mound was seen to develop below the localized recharge area with 12-14 h of intense rainstorms, and then dissipated over a period of 2-4 days. (Author's abstract)
W88-07574

MODELS OF THE EFFECT OF CLEARING ON SALT AND WATER EXPORT FROM A SMALL CATCHMENT,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07576

PREDICTION OF DELAYS IN GROUNDWATER RESPONSE TO CATCHMENT CLEARING,
Water Authority of Western Australia, P.O. Box 100, Lederville, W.A. (Australia).
For primary bibliographic entry see Field 4C.
W88-07577

ANALYSIS OF DRAWDOWN IN THE COUNTRY ROCK OF COMPOSITE DIKE AQUIFERS,
Euroconsult, Arnhem (Netherlands).
W. K. Boehmer, and J. Boonstra.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 199-214, October 30, 1987. 7 fig, 3 tab, 8 ref, append.

Descriptors: *Groundwater level, *Pumping tests, *Aquifers, *Drawdown, *Groundwater movement, *Dikes, *Pump wells, *Wells, Country rock, Groundwater, Rocks, Model studies, Mathematical analysis.

Approximate solutions to the problem of groundwater flow in a composite dike aquifer system are presented for the case that a well in the dike is pumped at a constant rate. These solutions yield curve-fitting procedures to evaluate the drawdown behavior of wells in the country rock. Procedures base on the authors' previous work contain both a distance-drawdown analysis and a time-drawdown analysis of observation wells in the country rock. They were tested for their validity with model and field tests. With common type-curve matching procedures early-time transient drawdown data can be analyzed to obtain the hydraulic diffusivity of the country rock. Together with the already published procedures to evaluate the drawdown behavior of wells in the dike, the method allows a complete analysis of all the hydraulic characteristics of a composite dike-aquifer system. The methods described are illustrated by aquifer test data of a field test. (Author's abstract)
W88-07578

ANISOTROPY AS A LIMIT OF LAYERING - THE DECAY OF A DISTURBED FREE SURFACE IN A POROUS MEDIUM,
Division of Hydraulic Machinery, SINTEF, N-7034 Trondheim-NTH (Norway).
K. M. Gjerde, and P. A. Tyvand.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 267-288, October 30, 1987. 7 fig, 1 tab, 10 ref.

Descriptors: *Groundwater movement, *Fluid mechanics, *Hydrodynamics, *Anisotropy, Gravitational decay, Boundary conditions, Theoretical analysis.

The gravitational decay of an initially disturbed, free surface of fluid within a porous medium was studied theoretically. The porous medium consists of an even number N of alternating layers, with different permeabilities and thicknesses. As the number of layers increases, the decay rate converges towards the value for homogeneous anisotropy, with a deviation proportional to N(-1) for large N. Two different boundary conditions are applied at the bottom of the porous medium: impermeable and hydrostatic. (Author's abstract)
W88-07581

GEOCHEMICAL CALCULATIONS AND OBSERVATIONS ON SALT WATER INTRUSIONS, I.A. COMBINED GEOCHEMICAL/MIXING CELL MODEL,
Institute for Earth Sciences, Vrije Universiteit, De Boelelaan 1085, 1081 HV Amsterdam (The Netherlands).
For primary bibliographic entry see Field 2L.
W88-07583

RELATIONSHIP OF SOIL SURFACE ROUGHNESS WITH HYDROLOGIC VARIABLES ON NATURAL AND RECLAIMED RANGE LAND IN NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.
For primary bibliographic entry see Field 4C.
W88-07585

OVERVIEW OF IMMISCIBLE FINGERING IN POROUS MEDIA,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W88-07621

SIMULATION PROCEDURE FOR GROUNDWATER QUALITY ASSESSMENTS OF PESTICIDES,
Environmental Research Lab., U. S. Environmental Protection Agency, Athens, GA 30613, U.S.A.
For primary bibliographic entry see Field 5B.
W88-07623

GROUNDWATER MUNITION RESIDUES AND NITRATE NEAR GRAND ISLAND, NEBRASKA, U.S.A.,
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 5B.
W88-07624

TRANSFORMATIONS OF TRACE HALOGENATED ALIPHATICS IN ANOXIC BIOFILM COLUMNS,
Geography and Environmental Engineering, The Johns Hopkins Univ., Baltimore, MD 21218, U.S.A.
For primary bibliographic entry see Field 5B.
W88-07625

PERSISTENCE AND TRANSPORT OF BACTERIA AND VIRUSES IN GROUNDWATER - A CONCEPTUAL EVALUATION,
Inst. of Geology and Paleontology, Kiel, F. R. Germany.
For primary bibliographic entry see Field 5B.
W88-07626

NUMERICAL CLASSIFICATION OF SALINE GROUNDWATER CHEMISTRY IN THE MURRUMBIDGEE IRRIGATION AREA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
B. G. Williams, J. K. Ward, and L. Belbin.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 337-345, 1987. 8 fig, 2 tab, 8 ref.

Descriptors: *Groundwater chemistry, *Salinity, *Groundwater, *Numerical analysis, Data interpretation, Mathematical studies, Distribution patterns, Chemical properties, Murrumbidgee Irrigation Area, Australia, Ions.

Numerical classification techniques were used to examine the chemical composition of 169 shallow groundwater samples in relation to their geographical distribution within the Murrumbidgee Irrigation Area (Australia). The ionic proportions are very similar throughout the whole area, but the total soluble salt concentrations are site specific with wide ranges of concentration occurring over relatively short distances. The reason for such variation is not known, but it is suggested that it may be a reflection of the residence time of water within individual sand lenses. The classification was more coherent when primary variables were used rather than derived variables such as Saturation Indices. (Wood-PTT)
W88-07699

SPECIAL GROUND-WATER STUDY: EXECUTIVE SUMMARY,
Susquehanna River Basin Commission, Harrisburg, PA.
P. B. Ballaron.
Publication No. 81. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. December

1982. 27 p, 1 tab.

Descriptors: *Groundwater, *Groundwater data, *Hydrologic models, *Hydrologic data, *Susquehanna River basin, *Pennsylvania, Wells, Model studies, Data collections, Ground water, Supply Inventory, Mathematical models, Aquifers, Groundwater movement, Surface-groundwater relations.

The fifteen projects and related supportive tasks comprising the Special Ground-Water Study have fulfilled the goals and objectives of the study – to develop specific groundwater data and management tools (models) in the Susquehanna River basin. The supportive data base has been significantly improved through: (a) the inventory of over 4,000 wells (and all major springs in the part of the Basin in Pennsylvania); (b) the entry of data from over 8,000 new wells into the USGS Ground Water Supply Inventory (GWSI) data base; and (c) the collection and analyses of 1,684 groundwater samples. Seven groundwater models developed during the study provide the Commission with tools for the management of groundwater in high-use areas. These models are capable of simulating and predicting the effects of droughts, large withdrawals from wells or well fields, and problems of groundwater contamination. Even in fractured rock aquifers in Pennsylvania, continuum methods of groundwater flow analysis can be used, depending on the scale of analysis and a qualitative correlation between features of the model-area flow system and a theoretical flow system. Valid numerical models were developed for both regional and more detailed studies and are useful in simulating surface-water/groundwater interrelationships and both natural and artificial stresses on the groundwater flow system. The resolution of the fractured-rock aquifer models is generally adequate for Commission water supply planning and management. Full model potential can be achieved only when data deficiencies or inaccuracies are corrected. Commission proficiency in groundwater hydrology was improved through the addition of professional staff. In addition, staff received training and experience both with specialized techniques and equipment during field data collection and through development and use of numerical models. (Lantz-PTT)
W88-07728

HYDROGEOLOGY OF THE OAK RIDGE GASEOUS DIFFUSION PLANT SITE,
Geraghty and Miller, Inc., Oak Ridge, TN.
P. D. Kuhlmeier, W. C. Sinclair, and J. L. Haymore.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010224. Price codes: A06 in paper copy, A01 in microfiche. Report No. K/SUB/85-22224/1, July 1986. 156 p, 20 fig, 2 tab, 16 ref, 3 append. DOE Contract No. 22K-22224K.

Descriptors: *Geohydrology, *Groundwater movement, *Path of pollutants, *Radioactive wastes, Aquifers, Groundwater, Monitoring, Groundwater recharge, Infiltration, Hydrological data collections, Solute transport.

Methods used and data collected to (1) evaluate the need for groundwater monitoring at 29 waste-storage/disposal sites, (2) conduct an investigation to characterize the geohydrology, and (3) design a groundwater monitoring program, at the Oak Ridge Gaseous Diffusion Plant, are described. Groundwater in the area is derived from local precipitation that infiltrates the uppermost aquifer and, in some areas moves into underlying bedrock aquifers. Groundwater flows from areas of recharge, downgradient, along relatively short and shallow flow paths toward areas of discharge. Discharge from both the surficial and bedrock aquifers is to the banks and bottoms of the Clinch River and Poplar Creek. Rate of groundwater flow in the surficial aquifer is very slow, on the order of 0.0001 ft/day, due to the low permeability of the unconsolidated aquifer material and the low gradients in the area. Movement of groundwater through fractures and solution conduits in some of the carbonate bedrock aquifers is quite rapid, even where gradients are not particularly steep. The specific geohydrology at each of the 14 waste-storage/disposal sites is discussed. Data collected for the study are included in the appendices. (Lantz-PTT)
W88-07742

DETAILED GEOLOGIC STUDIES ESTABLISH PERMEABILITY TRENDS FOR PLUME DEFINITION AND GROUND-WATER CLEAN-UP,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7A.
W88-07743

INFILTRATION AT YUCCA MOUNTAIN, NEVADA, TRACED BY CHLORINE-36,
Los Alamos National Lab., NM.
A. E. Norris, K. Wolfsberg, S. K. Gifford, H. W. Bentley, and D. Elmore.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011330. Price codes: A02 in paper copy, A01 in microfiche. Report No. LA-UR--87-2252, (1987). 6 p, 1 fig, 1 tab, 11 ref. DOE Contract No. W-7405-ENG-36.

Descriptors: *Infiltration, *Yucca Mountain, *Nevada, *Tracers, *Chlorine radioisotopes, Groundwater recharge, Geohydrology, Path of pollutants, Chloride, Arid lands, Rainfall infiltration.

Measurements of chloride and 36-Cl in soils from two locations near Yucca Mountain, Nevada, have been used to trace the infiltration of precipitation in this arid region. The results show that the 35-Cl fallout from nuclear weapons testing formed a well-defined peak at one location, with a maximum 0.5 m below the surface. The structure of the 36-Cl bomb pulse at the other location was much more complex, and the quantity of 36-Cl in the bomb pulse was < 1% of the 6 times 10 to the 12th power atoms 36-Cl/sq m in the bomb pulse at the first location. The data indicate hydrologic activity subsequent to the 36-Cl bomb pulse fallout at one location, but none at the other location. (Author's abstract)
W88-07748

TRITIUM IN GROUNDWATER AT SITE 300,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W88-07772

GWPATH: INTERACTIVE GROUND-WATER FLOW PATH ANALYSIS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7C.
W88-07780

GROUNDWATER AND AQUIFERS: AN OVERVIEW OF 'EXOTIC' USES,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 4B.
W88-07910

ENERGY POTENTIAL OF IRISH GROUNDWATERS,
Geological Survey of Ireland, Beggars Bush, Dublin 4, Ireland.
For primary bibliographic entry see Field 4B.
W88-07912

FLUCTUATING, NON-HOMOGENEOUS CHANGES OF HYDRAULIC CONDUCTIVITY IN POROUS MEDIA,
The Isotope Department, The Weizmann Institute of Science, Rehovot, Israel.
L. C. Goldenberg, S. Mandel, and M. Magritz.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 2, p 183-190, 1986. 7 fig, 1 tab, 24 ref.

Descriptors: *Porous media, *Permeability coefficient, *Saline water, *Sand Aquifers, *Clay minerals, Hydraulic conductivity, Aquifers, Deflocculation, Fluctuation, Seawater.

Evidence of formation of entrapped saline bodies of water in a porous medium where fresh water displaces flowing sea water was observed in laboratory experiments, was carried out on aquifer sands containing clay minerals. When sea water was flushed from these sands by fresh water, fluctuating changes of EC (electrical conductivity) appeared in the sample, and the hydraulic conductivity of the entire sample fluctuated before a lower value of hydraulic conductivity stabilized. These results are explained by a sequence of mechanisms: (a) formation of small pockets of seawater surrounded by semi-permeable membranes of deflocculated clay minerals; (b) bursting of the pockets by osmotic pressure and release of trapped sea water; and (c) deflocculation of clay minerals in the pockets formerly occupied by sea water. (Author's abstract)
W88-07913

ELECTRICAL CONDUCTIVITY AND SALINE CONCENTRATIONS IN ARID LAND GROUNDWATERS,
Department of Geography, The University, Nottingham, NG7 2RD, UK.
J. C. Doornkamp, and H. A. M. Ibrahim.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 3, p 249-250, 1986. 1 fig, 7 ref.

Descriptors: *Groundwater quality, *Water quality, *Electrical studies, *Geophysics, *Surveys, *Conductivity, *Salinity, *Groundwater, *Arid lands, Mathematical equations, Concrete construction, Agriculture, Sulfates, Chlorides, Bahrain, Port Said, Egypt, Nile delta, Saline water, Saline water intrusion, Land use, Evaporation.

Measurements in Bahrain (Doornkamp et al. 1980) have shown a strong linear relationship between electrical conductivity and the ionic concentrations of sulfates and chlorides in groundwaters. The relationship proved so strong as to imply that electrical conductivity could be used as a surrogate for sulfates and chlorides, and that the two ions could be estimated from electrical conductivity in field reconnaissance surveys or even site investigations. This is of critical importance to the construction industry and to agriculture in hot, arid lands. Concrete is known to deteriorate rapidly in the presence of saline groundwater, and any quick estimate of the sulfate and chloride levels is of practical value. Field measurements of electrical conductivity can be made rapidly using a portable electrical conductivity meter, while the laboratory analyses of sulfates and chlorides need care and introduce time delays, particularly for the construction industry, as well as additional costs. What has not been known is whether the results obtained in Bahrain provide a universally applicable relationship. To test this, two further analyses were carried out. The first is for data collected by the Egyptian Groundwater Research Institute (for the period 1974-79), and the second is for data collected by the authors for the Port Said area of Egypt. The results show that while strong relationships appear to be maintained between electrical conductivity and the ionic concentrations of sulfates and chlorides, the precise relationships appear to depend upon area and perhaps time. Local influencing factors may be sources of groundwater, penetration of seawater, local land uses, and rates of evaporation. (Brock-PTT)
W88-07914

LOCATING POTENTIAL BOREHOLE SITES IN A DISCORDANT FLOW REGIME IN THE CHALK AQUIFER AT LULWORTH USING INTEGRATED GEOPHYSICAL SURVEYS,
Hydrotechnica, Pengwern Court, High Street, Shrewsbury, SY1 1SR, UK.
For primary bibliographic entry see Field 7B.
W88-07915

GROUNDWATER MANAGEMENT PROBLEMS IN ABANDONED COAL-MINED AQUIFERS: A CASE STUDY OF THE FOREST OF DEAN, ENGLAND,
Bristol Univ. (England). Dept. of Geography.

For primary bibliographic entry see Field 4C.
W88-07916

PROBLEMS IN THE RECOGNITION OF SEA-WATER INTRUSION BY CHEMICAL MEANS: AN EXAMPLE OF APPARENT CHEMICAL EQUIVALENCE,
Birmingham Univ. (England). Hydrogeology Section.
For primary bibliographic entry see Field 5B.
W88-07917

NOBLE GAS COMPOSITION OF DEEP BRINES FROM THE PALO DURO BASIN, TEXAS,
Bendix Field Engineering Corp., Grand Junction, CO.
A. Zaikowski, B.J. Kosanke, and N. Hubbard.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 1, p 73-84, January 1987. 5 fig, 3 tab, 39 ref.

Descriptors: *Aquifers, *Saline aquifers, *Groundwater, *Brines, *Geochemistry, *Groundwater recharge, *Radioisotopes, *Chemical properties, *History, Noble gases, Mathematical models, Texas, Helium, Argon, Rock properties.

Deep groundwaters in sedimentary basins can be sufficiently old (10 m.y.) to have accumulated both radiogenic He4 and Ar*40. Differences in the ratio of (U + Th)/K for aquifer lithologies lead to variations for He4/Ar*40 in the groundwater. These variations can be used to resolve chronologically significant noble gas components. Application of a binary model to brine samples from the Palo Duro Basin, Texas yields (U, Th)-He4 residence times of 100 to 300 m.y. Concentrations of 2 non-radiogenic noble gases (Ne20 and Ar36) provide information on the salinities of the water that recharged these aquifers. (Author's abstract)
W88-07922

PROCESSES AND KINETICS OF CD(2+) SORPTION BY A CALCAREOUS AQUIFER SAND,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-07930

SR-ISOTOPIC EVIDENCE FOR DISCRETE SALINE COMPONENTS IN STRATIFIED GROUND WATERS FROM CRYSTALLINE BEDROCK, OUTOKUMPU, FINLAND,
Institute for Energy Technology, Box 40, 2007, Kjeller, Norway.
P. C. Smalley, R. Blomqvist, and A. Raheim.
Geology GLGYB, Vol. 16, No. 4, p 354-357, April 1988. 3 fig, 1 tab, 17 ref.

Descriptors: *Groundwater quality, *Strontium radioisotopes, *Saline water, *Saline-freshwater interfaces, *Stratification, Isotope studies, Boreholes, Water chemistry, Earth-water interfaces, Minerals, Aquifers, Rubidium.

The authors present a continuous Sr-isotope depth profile of waters, sampled in situ in the deepest borehole in Finland (approx. 1.1 km). The waters, all with a meteoric oxygen- and hydrogen-isotope signature, are compositionally stratified; a recent fresh water zone (0.05 mg/L Sr, Sr87/Sr86 > 0.730) approx. 400 m thick is underlain by two saline-water zones, the upper with approx. 25 mg/L Sr and Sr87/Sr86 = approx. 0.724, the lower with 45 mg/L Sr and Sr87/Sr86 = approx. 0.723. The Sr-isotope data show that the stratification is not due merely to upward dilution of saline water by fresh surface waters; two discrete saline waters are present. The two saline-water components are homogeneous in composition, apparently unaffected by local variations in rock composition either within the borehole or between neighboring boreholes. The implication is that the saline waters did not develop in isolated pockets but, rather, in large, well-mixed bodies. Most likely salinization mechanisms involve breakdown of low-Rb/Sr minerals (e.g., plagioclase feldspar) and/or of fluid inclusions. (Author's abstract)
W88-07951

DUPUIT-GHYBEN-HERZBERG ANALYSIS OF STRIP-ISLAND LENSES,
University of South Florida, Tampa. Dept. of Geology.
H. L. Vacher.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 4, p 580-591, April, 1988. 18 fig, 1 tab, 22 ref.

Descriptors: *Islands, *Saline-freshwater interfaces, *Groundwater movement, *Groundwater level, *Dupuit-Ghyben-Herzberg principle, Darcys law, Hydraulic conductivity, Groundwater recharge, Mathematical studies.

Dupuit-Ghyben-Herzberg analysis follows from combination of the continuity equation and Darcy's Law with the Ghben-Herzberg Principle and the Dupuit assumptions of horizontal flow. They analysis is used to derive the position of the water table and salt-water interface in island lenses in terms of island geometry, distribution of hydraulic conductivity (K), and distribution of recharge (R). For small islands and cases for which the salt-water head is zero, application of Dupuit-Ghyben-Herzberg analysis gives good results because the low R/K ratios of natural lenses assure that height/width ratios of natural lenses are extremely low, 1:30 to 1:100. Analytical solutions are developed for a number of infinite-strip islands. It is shown by analysis of the homogeneous, rectangular-island case that an island can be considered an infinite strip (to 0.1% accuracy) if its length/width ratio is larger than 4.4. Asymmetric lenses occur if the island is compose of strips of different K or different R, with the greater asymmetry occurring with difference in K. A high-K basement compresses the root of the lens and thereby decreases the water table in the island. A lens perched on impermeable basement has a higher water table than would otherwise occur in the island, but the volume of the lens is less. (Author's abstract)
W88-07953

GRID REFINEMENT APPROACH TO FLOW AND TRANSPORT MODELING OF A PROPOSED GROUNDWATER CORRECTIVE ACTION AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-07956

RECENT U.S. HOT DRY ROCK TESTING AND HYDROTHERMAL MODELING,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 8E.
W88-07966

TRACE RARE EARTH ELEMENT ANALYSIS IN BRINY GROUNDWATERS,
Battelle Pacific Northwest Labs., Richland, WA. Chemical Technology Dept.
J. C. Laul, E. A. Lepel, and M. R. Smith.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011185. Price codes: A02 in paper copy, A01 in microfiche. Report No. PNL-SA--14276, August 1986. 4 p, 1 fig, 1 ref. DOE Contract No. DE-AC06-76RL0 1830.

Descriptors: *Groundwater movement, *Geochemistry, *Rare earth elements, *Brines, *Tracer studies, Sodium chloride, Calcium, Radioactivity, Radioactive tracers, Radiochemical analysis.

The rare earth elements (REE) patterns in groundwaters can be used as in situ tracers to characterize the nature of source regions. The REE concentrations in briny groundwaters are very low and range from micrograms/L (ppb) to nanograms/L (ppt) levels. Briny waters usually contain NaCl in the range of 12-24% NaCl (2-4 M) and calcium in the range of 10-20% which interfere with the identification of the REE. A REE group separation scheme was developed that overcomes the problem of limited sensitivity in previously used detection methods. The separation scheme involves (1) pre-chemistry to concentrate the REE from a large volume (0.2 to 1 L) to a small volume (a few ml); (2) post-chemistry, following irradiation, in the presence of mixed REE carrier with subsequent count of the REE group aliquot; and (3) re-irradiation for chemical yield determinations. Using this technique, REE data were obtained for two briny groundwaters representing Granitic Wash (GW) and Wolfcamp Carbonate (WC) formations in the Palo Duro Basin. The REE patterns suggest that the GW and WC brines have different source regions. (Lantz-PTT)
W88-07981

2G. Water In Soils

ESTIMATING SAMPLE REQUIREMENTS FOR FIELD EVALUATIONS OF PESTICIDE LEACHING,
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
For primary bibliographic entry see Field 7A.
W88-06943

PREDICTION OF WATER RETENTION CHARACTERISTICS FROM SOIL COMPACTION DATA AND ORGANIC MATTER CONTENT,
Maiduguri Univ. (Nigeria). Dept. of Agricultural Engineering.
J. O. Ohu, G. S. V. Raghavan, S. Prasher, and G. Mehuys.
Journal of Engineering Agricultural Research JAERA2, Vol. 38, No. 1, p 27-35, September 1987. 5 fig, 3 tab, 18 ref.

Descriptors: *Soil water, *Soil moisture retention, *Soil compaction, *Model studies, Soil density, Soil organic matter, Organic matter, Soil physical properties, Topsoil, Available water, Estimating, Compaction, Clays, Clay loam, Sand.

Field soils often become compacted due to the untimely use of farm vehicles under a very tight calendar of farming operations. Soil compaction causes a significant deterioration of the structure of the top-soil which, in turn, affects the availability of water to plant roots. The latter can be estimated from a soil moisture retention curve. However, the curve is not a routinely measured soil property. Therefore, many empirical models have been proposed to estimate it from other, readily available, soil properties. Most of these models, however, are applicable to uncompacted soils. An empirical model is proposed that can estimate the soil moisture retention curve of any compacted soil. The soil physical properties that are required to estimate the model parameters are: bulk density, organic matter content, liquid limit and level of compaction. (Author's abstract)
W88-07074

ASSESSMENT OF RECHARGE COMPONENTS FOR A CHALK AQUIFER UNIT,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-07105

MANAGING SALINITY THROUGH CONJUNCTIVE USE OF WATER RESOURCES,
Central Soil Salinity Research Inst., Karnal (India). Div. of Agricultural Engineering.
For primary bibliographic entry see Field 3C.
W88-07162

CATION DEPLETION RATE AS A MEASURE OF SOIL SENSITIVITY TO ACIDIC DEPOSITION: THEORY,
Department of Ecology and Environmental Research, Swedish University of Agricultural Sciences, S-750 07, Uppsala, Sweden.
G. R. Gobran, and E. Bosatta.
Ecological Modelling ECMODT, Vol. 40, No. 1, p 25-36, January 1988. 3 fig, 2 tab, 29 ref.

Descriptors: *Soil water, *Cations, *Soil chemistry, *Acidic soils, *Acid rain, *Leaching, *Mathematical models, Theoretical analysis, Sensitivity analysis, Acidity, Equilibrium, Neutralization, Gaines-Thomas selectivity coefficient, Carbon dioxide, Sulfates, Calcium, Adsorption, Chemical precipitation, Soil classification, Hydrogen ion concentration.

A mathematical dynamic model was developed to simulate the relative effect of important factors affecting soil chemical equilibria and cation depletion in soils subjected to different acidic deposition regimes. The examined factors are: cation exchange capacity; base saturation; the Gaines-Thomas selectivity coefficient; partial pressure of carbon dioxide; sulfate retention (adsorption and precipitation); and specific leaching rate. These variables are shown to be strong determinants for soil leaching sensitivity, SLS, in terms of the ability of the soil to retain its cations against leaching. For example, a decrease of available calcium from 0.3 to 0.1 increases the SLS by 54%, so that the soil becomes more vulnerable to acidic deposition. This model is considered a first approach to estimating the importance of the kinetic reactions of soil variables. Such a dynamic model is useful in classifying soils as to their vulnerability to acidic deposition. It is concluded that pH is not an appropriate variable to use as an indicator of negative effects produced by acidic deposition. (Author's abstract)
W88-07163

CORRELATION BETWEEN SPATIALLY VARIABLE SOIL MOISTURE CONTENT AND SOIL TEMPERATURE,
Louisiana State Univ., Baton Rouge. Dept. of Agronomy.
B. Davidoff, and H. M. Selim.
Soil Science SOSCAK, Vol. 145, No. 1, p 1-10, January 1988. 10 fig, 3 tab, 18 ref.

Descriptors: *Soil water, *Soil temperature, *Correlation analysis, *Spatial distribution, Soil surfaces, Thermocouples, Infrared thermometry, Statistical analysis, Soil compaction, Kriging.

The spatial variation and correlation between gravimetrically measured soil surface moisture and surface temperature were studied by using thermocouple sensors (point measurements) and an infrared thermometer (area measurements). All measurements were taken on regular intervals along an 80-m transect on a bare soil. Both temperature and moisture exhibited cyclic behavior, which was attributed to possible differential soil compaction. The coefficient of variation for thermocouple temperatures was 54% smaller than that for infrared measurements. However, the means for both types of soil temperature measurements were not significantly different. In addition, based on semivariogram and autocorrelation analyses, the extent of spatial variability was similar for both types of temperature observations. The extent of spatial structure for soil moisture was less than that found for soil temperature. As a result, higher correlation coefficients between measured and kriged values (jackknifing procedure) were obtained for soil surface temperature (>0.83) than for surface soil moisture (>0.69). Removing the observed cyclic patterns from the original data drastically reduced the spatial variations of soil moisture, as well as temperature observations. (Author's abstract)
W88-07170

VARIABILITY OF SATURATED HYDRAULIC CONDUCTIVITY IN A GLOSSAQUIC HAPLUDALF WITH MACROPORES,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2F.
W88-07171

ARCTIC PEDOGENESIS: 2. THRESHOLD-CONTROLLED SUBSURFACE LEACHING EPISODES,
Environmental Protection Agency, HW-113, Seattle, WA.
M. G. Stoner, and F. C. Ugolini.
Soil Science SOSCAK, Vol. 145, No. 1, p 46-51, January 1988. 1 fig, 2 tab, 21 ref. NSF Grant DPP80-05795.

Descriptors: *Soil solution, *Leaching, *Arctic, *Soil genesis, Rainstorms, Storm seepage, Forest soils, Soil horizons, Translocation, Alaska.

The analysis of soil solutions generated by a large, isolated, summer rainstorm in the boreal forest of arctic Alaska has provided direct evidence for threshold-controlled subsurface translocation in soils. Intense leaching apparently initiates progressive weakening and eventual breakdown of amorphous particle coatings in the Bs horizon. The result is a highly punctuated pulse of organometallic soil plasma that originates in the Bs and temporarily transports material at over 100 times normal rates. Episodic pulse mechanisms of this type have not been reported before; they may play a critical role in the formation of other young or unstable soil environments. In this case they help explain the unusual morphology of Spodosols in arctic Alaska. (Author's abstract)
W88-07172

EFFECTS OF SCRUBBER SLUDGE ON SOIL AND DREDGED SEDIMENT AGGREGATION AND POROSITY,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W88-07173

ESTIMATION OF SURFACE WATER EVAPORATION RATES BY CONTINUOUS RADIOGAUGING,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
For primary bibliographic entry see Field 2D.
W88-07183

EFFECT OF BYPASS FLOW AND INTERNAL CATCHMENT OF RAIN ON THE WATER REGIME IN A CLAY LOAM GRASSLAND SOIL,
Amsterdam Univ. (Netherlands).
T. P. J. van Stiphout, H. A. J. van Lanen, O. H. Boersma, and J. Bouma.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 1-11, 15 November 1987. 7 fig, 1 tab, 18 ref.

Descriptors: *Infiltration, *Simulation, *Soil water, *Soil porosity, *Bypass channels, *Soil absorption capacity, *Rainfall infiltration, *Soil types, *Clay loam, *Soil-water-plant relationships, *Grasslands, Subsoil, Soil surfaces, Pressure head, Crops, Water deficit, Simulated rainfall.

Bypass flow was studied in a clay loam grassland soil with a loamy subsoil by means of laboratory experiments on large, undisturbed columns of surface soil. At a pressure head (h) of -1000 cm, bypass flow averaged 45% and at h = -200 cm 70% of applied rain (intensities of 20 and 35 mm/hour). Depth of infiltration of bypass water was studied in the field using morphological staining techniques and an infiltration experiment. Water, flowing into continuous cracks and worm channels, infiltrated into the subsoil at 60 and 135 cm depth respectively. This subsoil infiltration was called 'internal catchment'. Thus, the infiltration process differs from the classical concept of surface infiltration. Simulation with 1986 weather data was used to explore the effects on the water regime. Results indicate that crop water deficits differ significantly when bypass flow and internal catchment are taken into account. (Author's abstract)
W88-07188

SIMPLE METHOD TO ESTIMATE SPECIFIC EQUILIBRIUM SOIL-WATER CONTENT IN A UNIFORM SOIL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
J. M. Schouwenaars.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 13-17, 15 November 1987. 3 fig, 1 tab, 3 ref.

Descriptors: *Soil water, *Soil absorption capacity, *Groundwater level, *Water table fluctuations, *Water storage, *Soil profiles, *Estimating equations, Precipitation, Seepage, Soil types, Climates, Drainage discharge, Design critera.

Under 'near-equilibrium' conditions, reached after a period of wetness, within a uniform soil profile a relation exists between total water storage in the soil and groundwater depth. A simple method is presented to describe total water storage as a function of groundwater depth. When changes of total water storage are known (e.g., amount of precipitation, seepage), the fluctuations of the groundwater table can be calculated; when groundwater fluctuations are known (measured) variations in total water content can be derived and water-balance terms (e.g., precipitation, seepage), can be globally estimated. For periods in which the soil-water profile approaches near-equilibrium conditions after a wet period, this method offers a simple procedure for estimation of groundwater fluctuations that may be expected in different soil types and under different climatic conditions. The method can be applied to estimate the storage capacity of a given soil as required to determine design discharge for drainage. If the method is used to simulate groundwater fluctuations, its application should be restricted to suitable periods in which water content in the different soil layers does not differ strongly from the equilibrium soil-water profile. (Shidler-PTT)
W88-07189

SNOWMELT RUNOFF PATHWAYS IN A BOREAL FOREST HILLSLOPE, THE ROLE OF PIPE THROUGHFLOW,
Laboratory of Forest Hydrology, Department of Forest Sciences, Bureau 0866, Pavillon Vachon, Laval University, Sainte-Foy, Que. G1K 1P4, Canada.
J. Roberge, and A. P. Plamondon.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 39-54, 15 November 1987. 11 fig, 2 tab, 36 ref.

Descriptors: *Subsurface water, *Acidic water, *Acid rain, *Path of pollutants, *Snowmelt, *Groundwater runoff, *Pipe flow, *Forest soils, *Slopes, *Lakes, Precipitation, Unsaturated flow, Groundwater level, Turbulent flow, Soil horizons, Subsoil, Organic soils, Hydrographs, Hydrogen ion concentration, Stream gaging, Lake ice, Fish, Spawning, Canada.

On an instrumented slope of the Lac Laflamme basin (Quebec, Canada), it was observed that, during snowmelt season: (1) the unsaturated matrix flow seems to be a negligible component of the downslope flow through the soil horizons; (2) the groundwater flow from an aquifer in till, a few meters thick, is the major pathway for rain-melt inputs; and (3) when groundwater levels are high, a turbulent pipe throughflow occurs at the mineral and organic soils interface. Gauging one of the subsurface streams showed that, although its discharge is correlated and synchronized with nearby groundwater levels, its hydrograph often reflected that of rain-melt input. According to calculations, pipe throughflow does not carry more than one-fifth of the seasonal rain-melt input. During short periods (hourly basis) however, it may become the main source of water input to the lake. The water delivered by pipe throughflow forms a distinct 0.5-to-1-m-thick acidic layer (pH: 4.4-4.8) that invades the lake just beneath the lake ice cover and may affect the fish spawning ground. (Author's abstract)
W88-07191

WATER UPTAKE BY PLANT ROOTS--A SIMULATION MODEL: I. CONCEPTUAL MODEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
For primary bibliographic entry see Field 2I.
W88-07192

BEHAVIOR OF VARIOUS SOLUTES IN A FIELD SOIL: SIX YEARS OBSERVATION,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 5E.

W88-07195

MEASURE OF ISOTOPIC EQUILIBRIUM BETWEEN WATER, WATER VAPOUR AND SOIL CO2 IN ARID ZONE SOILS,
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
G. B. Allison, C. Colin-Kaczala, A. Filly, and J. C. Fontes.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 131-141, 15 November 1987. 3 fig, 2 tab, 19 ref.

Descriptors: *Soil water, *Isotope studies, *Water vapor, *Soil chemistry, *Carbon dioxide, *Arid zone, Sahara Desert, Oxygen isotopes, Deuterium, Free water, Africa, Deserts.

Some preliminary results from a sampling expedition in the Sahara suggest that it may be possible to use the isotope composition of either soil water vapor or soil carbon dioxide to obtain isotope profiles of soil water. Samples of soil air at atmospheric pressure were taken using a sampling probe which was driven into the soil. However, it is suggested that best results will be obtained if the samples of soil air are taken at reduced pressure. The use of a preparation line specifically designed for treating small samples of water allowed us to analyze both oxygen-18 and deuterium on a single water sample of about 5 microliters. Laboratory experiments are described that demonstrate that the isotope fractionation between soil water, even under very high matric suctions, and soil water vapor, is the same as that for free water. (Author's abstract)
W88-07197

COOL-SEASON TURFGRASS RESPONSES TO DROUGHT STRESS,
Rhode Island Univ., Kingston. Dept. of Natural Resources Science.
For primary bibliographic entry see Field 3F.
W88-07223

INFLUENCE OF SMALL MAMMALS ON STORMFLOW RESPONSES OF PINE-COVERED CATCHMENTS,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
For primary bibliographic entry see Field 4D.
W88-07286

SOME HYDROLOGIC IMPACTS OF PLOWING RANGELAND SOILS,
Utah State Univ., Logan. Watershed Science Unit.
For primary bibliographic entry see Field 4C.
W88-07291

MODELING OF WATER BALANCE, CRACKING AND SUBSIDENCE OF CLAY SOILS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
J. J. B. Bronswijk.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 199-212, February 15, 1988. 7 fig, 30 ref.

Descriptors: *Soil cracks, *Desiccation cracks, *Shrinking clays, *Hydrologic budget, *Model studies, *Clays, *Hydraulic conductivity, *Infiltration rate, *Soil water, *Soil moisture, *Hydrologic models, *Subsidence, Volumetric analysis, Simulation, Moisture transport, Groundwater level.

A general procedure was developed to model water balance, cracking and subsidence of clay soils. The main feature of this procedure is the introduction of the shrinkage characteristic in addition to the water retention and hydraulic conductivity curves into simulation models. The proposed procedure enables direct calculation of volume changes in dependence on moisture transport. With appropriate assumptions for geometry of swelling and shrinkage, these volume changes are converted into cracking and subsidence. Taking into account the calculated area of shrinkage cracks at the soil surface, together with the maximum infiltration rate of the soil matrix and the rainfall intensity, rainfall is dynamically partitioned in matrix and crack infiltration. In this way bypass flow and resulting rapid rises of groundwater levels in cracked soils can be simulated. The procedure was validated by adapting a model for calculation of transient moisture flow in soils, FLOWEX, into a version applicable on clay soils, FLOCR. Computations with FLOCR of subsidence, cracking, groundwater level and top layer wetness of a Dutch basin clay soil during 1985 were in good agreement with field observations. Moreover, the proposed method of bypass calculation is supported by good correspondence between measured and simulated rapid rises of groundwater levels. (Author's abstract)
W88-07306

MOVEMENT OF NITRITE THROUGH A LOESS SOIL,
Department of Soil Science, Faculty of Agronomic Sciences, Catholic University of Louvain, Place Croix du Sud 2, 1348 Louvain-la-Neuve (Belgium).
For primary bibliographic entry see Field 5B.
W88-07307

VARIABILITY OF SOIL MOISTURE DIFFUSIVITY OF LOAMY TO SILTY SOILS ON MARL, DETERMINED BY THE HOT AIR METHOD,
Department of Physical Geography, Geographical Institute, University of Utrecht, Heidelberglaan 2, 3508 TC Utrecht (The Netherlands).
J. A. Van Den Berg, and T. Louters.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 235-250, February 15, 1988. 6 fig, 4 tab, 41 ref.

Descriptors: *Soil moisture, *Diffusivity, *Loam, *Silt, *Soil texture, *Soil water, *Soil physical properties, *Hydraulic conductivity, Soil structure.

Various attempts have been made to estimate hydraulic characteristics from textural soil properties, often by testing models on materials with artificial packing. This approach prevents soil structure and the arrangement and orientation of soil particles from being taken into account. The moisture diffusivity characteristics of loamy to silty soils with intermediate soil moisture contents were examined. The relationship between diffusivity and soil moisture content was determined by the hot air method on undisturbed soil cores from eight different sites in the Ardeche Basin, France. The objectives were: (1) to obtain reproducible diffusivity values; (2) to distinguish between the natural and procedural variability; (3) to examine the spatial variability; and (4) to determine whether soil texture can be used to distinguish between the diffusivities of different loamy soils. It was found that the diffusivity of these soils can be related to the physiographic diversity of the area, rather than to soil texture. (Author's abstract)
W88-07309

EXPERIMENTAL AND NUMERICAL STUDIES OF SOLUTE TRANSPORT IN TWO-DIMENSIONAL SATURATED-UNSATURATED SOIL,
Wuhan Institute of Hydraulic and Electric Engineering, Wuhan, Hubei (P.R. of China).
For primary bibliographic entry see Field 5B.
W88-07312

EXACT NONLINEAR SOLUTION FOR CONSTANT FLUX INFILTRATION,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
G. C. Sander, J. Y. Parlange, V. Kuhnel, W. L. Hogarth, and D. Lockington.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 341-346, February 15, 1988. 1 fig, 5 ref.

Descriptors: *Oil-water interfaces, *Infiltration, *Boundary conditions, Groundwater movement.

Recently an analytical nonlinear solution to the problem of two phase oil and water infiltration under a constant flux boundary condition was derived. We show that this solution also applies to the problem of constant infiltration of water by introducing a very simple change in the independent variables of space and time. (Author's abstract)
W88-07314

CIVIL ENGINEER'S POINT OF VIEW ON WATER TIGHTNESS AND CLOGGING OF WASTE STABILIZATION PONDS,
CEMAGREF, Division Mecanique des Sols et Genie Civil, B.P. 121, 92164 Antony Cedex, France.
For primary bibliographic entry see Field 5D.
W88-07370

EFFECT OF SOIL PROPERTIES AND A SYNTHETIC MUNICIPAL LANDFILL LEACHATE ON THE RETENTION OF CD, NI, PB, AND ZN IN SOIL AND SEDIMENT MATERIALS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5B.
W88-07423

PREDICTION OF WICK DRAIN PERFORMANCE USING PIEZOMETER CONE DATA,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 8D.
W88-07426

LABORATORY DETERMINATION OF DIFFUSION COEFFICIENTS OF CONTAMINANTS USING UNDISTURBED CLAYEY SOIL,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5B.
W88-07427

TILL BEHAVIOR AND ITS RELATIONSHIP TO ACTIVE-LAYER HYDROLOGY, DISTRICT OF KEEWATIN, NORTHWEST TERRITORIES,
Department of Geological Sciences, Queen's University, Kingston, Ont., Canada K7L 3N6.
For primary bibliographic entry see Field 8D.
W88-07428

SEEPAGE FROM CHANNELS AND PONDS WITH IMPERVIOUS BOUNDARY WALLS EXTENDING BELOW FLOOR LEVEL,
Soils Division, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ (U.K.).
E. G. Youngs.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 193-205, July 15, 1987. 10 fig, 5 ref.

Descriptors: *Seepage, *Reservoirs, *Channels, *Soil properties, *Channel loss, *Hydraulic models, *Infiltrometers, Model studies, Analog models, Water loss.

The steady-state seepage after long times from flat bottomed channels into 'Green and Ampt' type soils is analyzed using the method of conformal transformations for the case of an impervious boundary wall extending below floor level. Relationships, expressed in dimensionless form, are given showing the dependence of the seepage rate on the depth of the boundary wall and soil hydraulic properties. Similar relationships, obtained by an electric analogue that approximate the hydraulic situation, are presented for the case of a circular pond with an impervious boundary wall. These relationships are useful not only for estimating the seepage from channels and reservoirs but also for analyzing results from infiltrometer rings. (Author's abstract)
W88-07510

TRANSFER FUNCTION MODEL FOR THE PREDICTION OF NITRATE LEACHING UNDER FIELD CONDITIONS,
Oxford Univ. (England). Dept. of Plant Sciences.
For primary bibliographic entry see Field 5B.
W88-07511

SIMULATION OF WATER DISCHARGE RATES FROM A CLAY-TILL SOIL OVER A TEN YEAR PERIOD,

Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
A. Gustafson.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 263-274, July 15, 1987. 7 fig, 2 tab, 23 ref.

Descriptors: *Mathematical models, *Model studies, *Groundwater, *Soil water, *Drainage systems, *Subsurface drainage, *Tile drains, Crops, Drains, Drainage, Subsurface water, Groundwater discharge, Piezometers, Meteorological data.

A physically based numerical model was used to predict daily rates of water discharge through tile drains, groundwater table, and groundwater discharge rates over a ten year period. The model, which was run on standard meteorological data as input, was adapted for use on a field of arable land in southern Sweden. The output was compared with data from continuous discharge measurements and piezometer readings taken at two week intervals. Parameters related to soil properties were partially based on a previous study at a nearby field with similar soil. The agreements between simulations and measurements were fairly good when account was taken of the specific crop used and its seasonal course. The most successful simulations were achieved under flood conditions in unfrozen ground. Repeated freezing and thawing led to pronounced discrepancies and actual observations. The role of groundwater discharge below the drainpipes was demonstrated and the simulated groundwater discharge averaged 18% of the total discharge. Despite some shortcomings concerning winter conditions, the model is a useful tool for predicting water movements in arable soils. (Author's abstract)
W88-07514

WATER LOSSES FROM IRRIGATION CANALS,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-07515

ANALYSIS OF A CLOSED-FORM ANALYTICAL MODEL TO PREDICT THE HYDRAULIC CONDUCTIVITY FUNCTION,
Department of Rural Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, GR-504 06 Thessaloniki (Greece).
M. Sakellariou-Makrantonaki, C. Tzimopolos, and D. Gouliaras.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 289-300, July 15, 1987. 4 fig, 1 tab, 31 ref, 1 append.

Descriptors: *Permeability coefficient, *Model studies, *Hysteresis, *Soil water, *Hydraulic conductivity, *Hygroscopic coefficient, Soil types.

Because measurements of the hydraulic conductivity relationship, K(theta), are time consuming many researchers have suggested the use of prediction models. Recently, a closed-form model was proposed, derived from an integral relation. An attempt was made to check this model for 10 soils described in the literature, especially the existence of hysteresis in the predicted relative hydraulic conductivity relations. The magnitude of the parameter n is a determining factor whether or not hysteresis will occur in the relative hydraulic conductivity (theta) relation. Sensitivity analysis showed that relative hydraulic conductivity is relatively insensitive to n when the soil is not too dry. The exponent n, as with a parameter lambda, defines the pore size distribution which becomes uniform at large values of n. Comparison of relative hydraulic conductivity (theta) as predicted for wet and dry conditions showed that the proposed model is reasonably accurate: (1) when the values of the ultimate boundary characteristic curves of the hysteretic loop are small and have approximately the same value; and (2) for larger n values differing in n. (Author's abstract)
W88-07516

SOIL MOISTURE MEASUREMENT BY AN IMPROVED CAPACITANCE TECHNIQUE: I. SENSOR DESIGN AND PERFORMANCE,
Institute of Hydrology, Wallingford (England).
T. J. Dean, J. P. Bell, and A. J. B. Baty.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 67-78, August 15, 1987. 8 fig, 1 tab, 9 ref.

Descriptors: *Soil water, *Soil moisture meters, *Soil physical properties, *Instrumentation, *Sensors, Electrical properties, Electronic equipment, Dielectric constant, Soil.

Dielectric constant is a sensitive measure of the moisture content of soil. One method of measuring the dielectric constant of soil in the field is to incorporate the soil as part of the dielectric of a capacitor. A new capacitance sensor operating at 150 MHz makes use of advances in electronic component technology to give a stable and sensitive probe for in-situ field measurements. The sensor has been developed as part of an integrated system of soil moisture measurement comprising in addition a technique for access tube installation and appropriate calibration. (See also W88-07526) (Author's abstract)
W88-07525

SOIL MOISTURE MEASUREMENT BY AN IMPROVED CAPACITANCE TECHNIQUE: II. FIELD TECHNIQUES, EVALUATION AND CALIBRATION,
Institute of Hydrology, Wallingford (England).
J. P. Bell, T. J. Dean, and M. G. Hodnett.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 79-90, August 15, 1987. 6 fig, 3 ref.

Descriptors: *Soil water, *Soil physical properties, *Sensors, *Electronic equipment, *Instrumentation, *Soil moisture meters, Calibrations, Dielectric constant, Gravimetric determination, Capacitance probe.

The comparison of the capacitance method was compared with established methods of defining and determining water content using the neutron probe and the gravimetric technique. The relationship between the capacitance probe readout and water content is not linear and is influenced by the type of soil. Emphasis was placed on field rather than laboratory calibrations, however, and a linear approximation is adequate for the restricted ranges of water content experienced in practice in many soils. Access tubes must be installed with greater care than for the neutron probe. A technique has been developed that combines installation with collection of relevant samples for gravimetric determination. (See also W88-07525) (Author's abstract)
W88-07526

PHYSICALLY-BASED MODEL FOR THE AGROHYDROLOGIC PROCESSES,
For primary bibliographic entry see Field 2A.
W88-07560

COMPARISON OF VARIOUS METHODS TO SCALE SOIL HYDRAULIC PROPERTIES,
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
J. W. Hopmans.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 241-256, September 15, 1987. 6 fig, 3 tab, 21 ref.

Descriptors: *Soil water, *Soil physical properties, *Soil analysis, *Mathematical studies, *Hydraulic conductivity, Soil properties, Permeability coefficient, Evapotranspiration, Hydraulic properties, Comparison studies.

Soil water characteristic curves and hydraulic conductivity functions at 57 locations were scaled by various methods. Optimum scaling results were obtained when pressure head and conductivity data were scaled by different methods. Criteria that supported this conclusion were: (1) the percent reduction in sum of squares; (2) the correlation between unscaled and estimated pressure head values as obtained from the scaled mean hydraulic functions; and (3) correlation between scaling factors determined from soil water characteristic data and those determined from hydraulic conductivity data. Both sets of scaling factors were found to be lognormally distributed. A correlation of R squared = 0.761 was obtained between scaling factors determined from soil water characteristic data and those determined from hydraulic conductivity data. For the optimum scaling methods, the sum of squares, about the average curve, was reduced by 73 and 42%, for the water characteristic and hydraulic conductivity data, respectively. The results suggest that scaling can successfully be used for describing the variability of soil hydraulic properties of different soil map units and horizons. (Author's abstract)
W88-07562

RESPONSE OF INPUT AND OUTPUT OF WATER AND CHLORIDE TO CLEARING FOR AGRICULTURE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07568

SOIL WATER DYNAMICS OF LATERITIC CATCHMENTS AS AFFECTED BY FOREST CLEARING FOR PASTURE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07569

AREAL DISTRIBUTION OF INFILTRATION PARAMETERS AND SOME SOIL PHYSICAL PROPERTIES IN LATERITIC CATCHMENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, R. J. W. Barron, and M. S. Fernie.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 109-127, October 15, 1987. 9 fig, 3 tab, 29 ref.

Descriptors: *Rainfall-runoff relationships, *Land claring, *Soil water, *Soil physical properties, *Subsurface water, *Hydraulic conductivity, *Laterites, *Recharge, *Infiltration, *Forest clearing, *Catchment areas, Hydrology, Runoff, Australia, Agriculture, Soil types, Groundwater movement, Land use.

The spatial distribution, dependence and variability of infiltration parameters (sorptivity and saturated hydraulic conductivity) measured was in-situ at two grid spacings of 1 X 1 m and 100 X 150 m in two adjacent lateritic catchments near Collie, Western Australia. An exponential semivariogram with trend was required to describe the spatial structure, and due to the presence of nested structures, the zone of influence could not be specified precisely. Using a correspondence analysis based on infiltration properties, the surface soils of a 94 ha catchment were classified into seven classes. However, this classification did not correspond with the existing classification into soil units or hydrologic provinces. It is suggested that the existing soil classification will be of limited value in assessing the infiltration capacity of soils in this region. The lateritic soils have very high infiltration rates particularly in the forested catchment. For one soil unit, two years after a change in land use from forest to pasture, the infiltration rate was retarded significantly (saturated hydraulic conductivity by 10 times and sorptivity by a factor of 3). Despite this, considering the rainfall characteristics of the region, it is concluded that in most conditions the infiltration capacity of surface soils will not be limiting, and there is little probability of direct surface runoff. The dominant mechanism of runoff generation in the agricultural land appears to be saturation of surface soils through subsurface flow due to enhanced recharge after forest clearing. (Author's abstract)
W88-07573

PREFERRED WATER FLOW AND LOCALIZED RECHARGE IN A VARIABLE REGOLITH,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of

Groundwater Research.
For primary bibliographic entry see Field 2F.
W88-07574

PREDICTION OF DELAYS IN GROUNDWATER RESPONSE TO CATCHMENT CLEARING,
Water Authority of Western Australia, P.O. Box 100, Lederville, W.A. (Australia).
For primary bibliographic entry see Field 4C.
W88-07577

SOIL WATER REGIME DESCRIBED BY A BIDIMENSIONAL STEADY-STATE FLOW IN A CULTIVATED AND IRRIGATED SOIL, I. THEORY (REGIMES PERMANENTS BIDIMENSIONNELS D'INFILTRATION DANS UN SOL CULTIVE ET MICROIRRIGUE, I. THEORIE.),
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
J. F. Boulier, and M. Vauclin.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 355-370, October 30, 1987. 4 fig, 3 tab, 19 ref.

Descriptors: *Soil water, *Irrigation, *Mathematical models, *Subsurface flow, *Cultivated lands, Croplands, Mathematical equations, Fourier analysis.

The soil water regime under a crop irrigated by equally spaced line-sources is described by a bidimensional steady-state flow. Mathematical solutions of the linearized equation resulting from an exponential relationship between unsaturated hydraulic conductivity and soil-water pressure, were obtained by means of Fourier's analysis in the case of linear boundary conditions and when root extraction is a known function of space coordinates. In particular flow was calculated when a saturated strip at the soil surface is spreading from the line source. Solutions and their convergence are illustrated and discussed. An example demonstrated that mathematical solutions are physically meaningful only under restricted conditions. (See also W88-07587) (Author's abstract)
W88-07586

SOIL WATER REGIME DESCRIBED BY A BIDIMENSIONAL STEADY-STATE FLOW IN A CULTIVATED AND IRRIGATED SOIL, II. COMPARISON BETWEEN THEORY AND FIELD MEASUREMENTS (REGIMES PERMANENTS BIDIMENSIONNELS D'INFILTRATION DANS UN SOL CULTIVE ET MICROIRRIGUE, II. COMPARAISON DE LA THEORIE AVEC DES MESURES IN-SITU),
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
J. F. Boulier, and M. Vauclin.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 371-394, October 30, 1987. 10 fig, 5 tab, 19 ref, append.

Descriptors: *Soil water, *Irrigation, *Mathematical models, *Subsurface flow, *Cultivated lands, Croplands, Mathematical equations, Crops, Sorghum, Maize, Hydraulic conductivity, Stochasticity, Tensiometers, Comparison studies.

An experimental plot of 2500 sq m was cultivated and irrigated by line sources (trickle irrigation), in order to compare the theory presented in the first part of the paper with measurements during two years (sorghum, maize). In addition a stochastic-conceptual model taking into account the spatial variability of the soil hydraulic characteristics described by means of a scaling factor (according to porous media's similitude theory) was developed. Field-averages and variances of variables associated with the flow were calculated according to this model and compared with actual ones measured all over the field-plot. Fourteen sites equipped for measuring water content (neutron access tubes) and water pressure (tensiometers) were chosen so that they represented the statistical distribution of a single parameter showing the textural variation in this loamy soil. The experimental results show that the steady-state approach is reasonable for water content on a weekly basis but is questionable for water pressure. Agreement between the deterministic model with a fitted water extraction model and the measurements at two sites is correct in the irrigated row and their differences, particularly in the driest parts of the soil, are discussed. The stochastic approach gives averaged water-content values close to the experimental ones but underestimates the variances, especially for sorghum. Although for this particular field plot deterministic modelling cannot be rejected as far as water content is concerned, the estimation of the mean behavior through tensiometric measurements seems rather risky. (See also W88-07586) (Author's abstract)
W88-07587

CHARACTERIZING THE UNCERTAINTY OF PESTICIDE LEACHING IN AGRICULTURAL SOILS,
Environmental Research Lab., U. S. Environmental Protection Agency, Athens, GA 30613, U.S.A.
For primary bibliographic entry see Field 5B.
W88-07622

SIMULATION PROCEDURE FOR GROUNDWATER QUALITY ASSESSMENTS OF PESTICIDES,
Environmental Research Lab., U. S. Environmental Protection Agency, Athens, GA 30613, U.S.A.
For primary bibliographic entry see Field 5B.
W88-07623

SPATIAL VARIABILITY OF WATER AND SOLUTE TRANSPORT PROPERTIES IN UNSATURATED SOIL: I. ANALYSIS OF PROPERTY VARIATION AND SPATIAL STRUCTURE WITH STATISTICAL MODELS,
W. A. Jury, D. Russo, G. Sposito, and H. Elabd.
Hilgardia, Vol. 55, No. 4, p 1-32, July, 1987. 12 tab, 85 ref.

Descriptors: *Spatial distribution, *Solute transport, *Soil types, *Soil physical properties, *Statistical models, *Saturation, *Soil water, Distribution, Model studies, Statistical analysis, Statistical methods, Mathematical studies, Water transport, Permeability coefficient, Infiltration rate, Correlation analysis, Stochastic process, Hydraulic properties.

The spatial structure of groundwater transport systems was studied statistically, revealing field properties that are not apparent from a simple calculation of the statistical moments of the set of parameter measurements. The study demonstrated the extreme sensitivity of the estimate of the integral scale parameter to the type of model used for the semivariogram, to the assumption of drift, and to the type of validation test used to confirm the estimation procedure. Greater care must be taken in future studies to utilize more sophisticated estimation procedures and to analyze for drift components. Stochastic analysis of water or solute transport in the unsaturated zone requires knowledge of the spatial distribution of soil hydraulic properties (soil hydraulic conductivity and water content-water potential functions) as well as the spatial distribution of the components of the dispersion tensor. This task may be eased by using the scaling factor concept, which involves viewing a scaling factor as a stochastic variable so that the spatial variability of soil hydraulic properties may be described by a univariate instead of a multivariate parameter distribution. (See also W88-07674) (Doria-PTT)
W88-07673

SPATIAL VARIABILITY OF WATER AND SOLUTE TRANSPORT PROPERTIES IN UNSATURATED SOIL: II. SCALING MODELS OF WATER TRANSPORT,
W. A. Jury, D. Russo, and G. Sposito.
Hilgardia, Vol. 55, No. 4, p 33-56, July, 1987. 16 tab, 41 ref.

Descriptors: *Water transport, *Soil water, *Vadose water, *Model studies, *Stochastic process, *Spatial distribution, *Hydraulic properties, Distribution, Permeability coefficient, Statistical analysis, Mathematical analysis, Regressional analysis, Saturation, Estimating, Estimating equations, Mathematical equations, Mathematical studies.

The possibility is examined of introducing a single stochastic parameter, alpha, to describe the spatial variability of soil hydraulic properties, using the soil hydraulic properties of the Hamra field and the Panoche field. In the traditional approach, sets of scaling factors are estimated from the h(s) and K(s) functions. Although the sets of alpha were found to be correlated, they possessed different statistical properties and were not identical. Results of structural analyses of the sets of alpha from the two fields suggested that the spatial structures of the two alpha-sets are quite distinct, reflecting the different spatial behavior of the h(theta) and K(theta) functions. Moreover, there was poor correlation between the uncorrelated residuals of the alpha-sets, indicating that part of the high correlation between the alpha-sets found in earlier work must stem from the presence of an undetected drift and from correlation between nearby measurements. It is concluded that, in any transient transport problem involving both K(s) and h(s), the description of their spatial variability requires the use of at least three stochastic variates (K sub s, alpha, and eta) and not alpha alone. (See also W88-07673) (Doria-PTT)
W88-07674

RE-EVALUATION OF THE WELL PERMEAMETER AS A FIELD METHOD FOR MEASURING HYDRAULIC CONDUCTIVITY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
T. Talsma.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 361-368, 1987. 4 fig, 2 tab, 25 ref.

Descriptors: *Well permeameter, *Well hydraulics, *Hydraulic conductivity, *Soil properties, Unsaturated flow, Soil types, Mathematical studies, Mathematical equations, Boreholes, Capillarity, Infiltration, Estimating.

Improved theory of steady outflow of water ponded to constant depth in holes drilled in unsaturated soil is used to re-evaluate the well permeameter method for measurement of in situ hydraulic conductivity, K sub O. In particular, theory predicts that neglect of unsaturated flow into soil surrounding the saturated region around a borehole may lead to serious overestimation of K sub O, especially when using small holes with high capillarity, i.e. the capillarity factor is 0.1-1/m. Field studies on 12 soils gave capillarity values from 6 to 35/m, resulting in theoretical overestimates of K sub O by 10-40%, for boreholes > or = 0.3 m deep and > or = 0.03 m radius. Comparison of results obtained by measurements with this method for four soils, however, gave permeameter values of K sub O which were approximately 50% of those obtained with the augerhole or the core method. Overestimation of K sub O due to neglect of capillarity was, in all cases, more than offset by reduction in K sub O due to pore closure around a hole during drilling and infiltration. (Author's abstract)
W88-07700

ESTIMATION OF PARAMETERS FOR THE PHILIP TWO-TERM INFILTRATION EQUATION APPLIED TO FIELD SOIL EXPERIMENTS,
Division of Soils, Commonwealth Scientific and Industrial Organization, P.M.B., P.O. Aitkenvale, Qld 4814.
K. L. Bristow, and M. J. Savage.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 369-375, 1987. 2 fig, 2 tab, 15 ref.

Descriptors: *Infiltration, *Infiltration coefficient, *Philip two-term infiltration equation, *Mathematical studies, Soil water, Data interpretation, Estimating equations, Estimation, Mathematical equations, Least squares method, Australia.

Two methods based on least squares analysis used to estimate coefficients in the Philip two-term infiltration equation are compared. The one method

maintains the infiltration equation in its original form, while the other involves a mathematical transformation which introduces self-correlation and yields different estimates of the coefficients. Data from field infiltration experiments conducted in the Torrens Creek area of northeast Queensland are used to illustrate these differences, and the need to distinguish between fitting data to empirical models and deriving system parameters from analysis of physically based models is emphasized. The method maintaining the Philip two-term infiltration equation in its original form is the preferred procedure for evaluating both system and empirical parameters since it is potentially more accurate than the method involving the transformed equation. (Wood-PTT)
W88-07701

MODIFIED RUNOFF CURVE NUMBERS FOR BARE CRUST-FORMING SANDY SOILS,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2E.
W88-07704

INFILTRATION AT YUCCA MOUNTAIN, NEVADA, TRACED BY CHLORINE-36,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 2F.
W88-07748

TRANSFORMATIONS AND TRANSPORT OF NITROGEN,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W88-07824

CHEMICAL PROCESSES AND TRANSPORT OF PHOSPHORUS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-07825

AMINO ACID ADSORPTION BY CLAY MINERALS IN DISTILLED WATER,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2K.
W88-07924

THERMAL REGIME OF PEATLANDS IN SUBARCTIC EASTERN CANADA,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W88-07936

UPFREEZING PROCESS: EXPERIMENTS WITH A SINGLE CLAST,
Washington Univ., Seattle. Quaternary Research Center.
For primary bibliographic entry see Field 2C.
W88-07954

RISK ASSESSMENT OF SOIL CONTAMINATION CRITERIA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5C.
W88-07957

ANALYTICAL METHODS MANUAL FOR THE DIRECT/DELAYED RESPONSE PROJECT SOIL SURVEY,
Lockheed Engineering and Management Services Company Inc., Las Vegas, NV 89119.
For primary bibliographic entry see Field 7A.
W88-07960

2H. Lakes

MATHEMATICAL ASPECTS OF TRAPPING MODES IN THE THEORY OF SURFACE WAVES,
Dept. of Mathematics, Univ. of Manchester, Manchester M13 9PL, UK.
For primary bibliographic entry see Field 8B.
W88-06819

DIEL PERIODICITY IN DENSITY OF EPHEMEROPTERA NYMPHS ON STREAM SUBSTRATA AND THE RELATIONSHIP WITH DRIFT AND SELECTED ABIOTIC FACTORS,
Alberta Univ., Edmonton. Dept. of Zoology.
R. J. Casey.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 12, p 2945-2952, December 1987. 5 fig, 3 tab, 35 ref.

Descriptors: *Insects, *Nymphs, *Stream biota, *Population density, *Diurnal distribution, *Distribution patterns, *Light intensity, Cloud cover, Water temperature, Stream beds, Moonlight, Drift, Photoperiodism.

The diel periodicity in density of Ephemeroptera nymphs on an undisturbed stream bottom was documented by direct observation. The study was conducted in a second-order Rocky Mountain foothill stream in Alberta. Observations were made for 24-h periods, twice during a new moon and twice during a full moon; the times of the dark and light periods were noted. Noctural observations were made using a red light. The abundance of drifting nymphs, incident light, percent cloud cover in the sky, and water temperature were recorded to determine if they were related to the observed diel periodicity on top of the substratum. The taxonomic groups of Ephemeroptera nymphs examined were Cinygmula, Heptageniidae (Cinygmula and Epeorus), Baetis, Baetis-Ameletus, Ameletus, Drunella coloradensis Dodds, and total fauna (all groups including minor taxa). In response to the artificial light used for observations, total fauna, Cinygmula, and Baetis nymphs were not affected by the light, and the nymphs were not found to be negatively phototactic. Total fauna and Heptageniidae nymphs exhibited a diel periodicity between 24-h periods; the Baetis-Ameletus group also had a diel periodicity. Cinygmula, Baetis, and D. coloradensis nymphs did not exhibit a diel periodicity. Most taxonomic groups were at greater densities on the top of the substratum in the dark period than in the light period. For small and large size classes of nymphs examined, only the small Heptageniidae and Baetis-Ameletus nymphs showed a diel periodicity in density. Drift of the common groups of nymphs was aperiodic and not statistically correlated with the diel density of nymphs on the substratum. In general, incident light, percent cloud cover, and water temperature were not correlated with the diel density of the taxonomic groups on the top of the substratum. (Author's abstract)
W88-06822

GROWTH AND PHYSIOLOGICAL CONDITION OF BLACK DUCKS REARED ON ACIDIFIED WETLANDS,
Dept of Animal Science, Cook College, Rutgers - The State University, New Brunswick, NJ 08903.
For primary bibliographic entry see Field 5C.
W88-06823

LONG-TERM SURVIVAL OF ESCHERICHIA COLI IN RIVER WATER,
Dept. of Biological Sciences, Univ. of Warwick, Coventry CV47AL, UK.
For primary bibliographic entry see Field 5B.
W88-06834

FREQUENCY OF ERWINIA CAROTOVORA IN THE ALYTH BURN IN EASTERN SCOTLAND AND THE SOURCES OF THE BACTERIUM,
Scottish Crop Research Inst., Invergowrie, Dundee DD2 5DA, UK.
For primary bibliographic entry see Field 5B.
W88-06835

OCCURRENCE OF GLOCHIDIA IN STREAM DRIFT AND ON FISHES OF THE UPPER NORTH FORK HOLSTON RIVER, VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
R. J. Neves, and J. C. Widlak.
American Midland Naturalist AMNAAF, Vol. 119, No. 1, p 111-120, January 1988. 1 fig, 5 tab, 37 ref. US Fish and Wildlife Service permit PR2-7375.

Descriptors: *Drift, *Mussels, *Larvae, *Glochidia, *Streams, *Fish, *Parasites, *Parasitism, Seasonal variation, Population density, Minnows, Perch.

Occurrence of glochidia in stream drift, and prevalence and intensity of glochidial infestations on host fishes were recorded in the upper North Fork Holston River near McCrady, Virginia, between June 1981 and June 1982. Glochidia of Lampsilinae were collected in drift samples year-round, peaking in abundance during June and July. Glochidia of the Ambleminae were in the drift from June to mid-August. Of 4800 fish (41 species) examined for infestations, 14% carried encysted glochidia. Eleven fish species in the Centrarchidae, Cottidae and Percidae were infested with lampsiline glochidia, with prevalence highest in March. Amblemine glochidia occurred only in 12 species of the Cyprinidae, with prevalence highest in July. Prevalence and intensity of infestations were highest in fish hosts of the Ambleminae. Previous accounts of host specificity, based on laboratory experiments with naiades, were corroborated by field observations. (Author's abstract)
W88-06836

EFFECTS OF CLEAR-CUT LOGGING ON WOOD BREAKDOWN IN APPALACHIAN MOUNTAIN STREAMS,
Biology Dept., Virginia Polytechnic Institute and State Univ., Blacksburg, VA 24061.
For primary bibliographic entry see Field 4C.
W88-06837

EFFECT OF SALINITY ON LEAF IONIC CONTENT AND PHOTOSYNTHESIS OF TAXODIUM DISTICHUM L.,
Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.
S. R. Pezeshki, R. D. DeLaune, and W. H. Patrick.
American Midland Naturalist AMNAAF, Vol. 119, No. 1, p 185-192, January 1988. 5 fig, 17 ref. NSF Grant BSR-8414006.

Descriptors: *Salinity, *Leaves, *Ions, *Photosynthesis, *Bald cypress trees, *Deciduous trees, *Flooding, *Saline water, *Saline water intrusion, Stomatal transpiration, Carbon dioxide, Mississippi Delta, Louisiana, Subsidence, Sodium, Potassium, Calcium, Magnesium.

Bald cypress (Taxodium distichum L.) seedlings were subjected to flooding with salinity levels ranging from 0-140 moles/cu m NaCl. Imposition of salinity was designed to simulate the increase in salinity level which some of Louisiana's extensive cypress forests are currently experiencing due to rapid subsidence in the Mississippi River Deltaic Plain. The effect of salt water on leaf tissue ion concentrations and subsequent changes in net photosynthesis were measured. Leaf concentrations of Na, K, Ca and Mg increased substantially as salinity of floodwater increased. Net photosynthesis declined from 7.6 micromoles/sq m/s to 0.9 micromoles/sq m/s when salinity increased from 0-140 moles/cu m NaCl. Despite the parallel reduction in both stomatal conductance and net photosynthesis, the leaf internal CO2 concentrations remained relatively constant over the entire range of salt concentrations. These results suggest that elevated floodwater salinity causes excess accumulation of several ions in the bald cypress leaf tissue. Consequently, increase in leaf ionic content is primarily the cause of reductions in photosynthesis which is accompanied by simultaneous diffusional limitations caused by stomatal closure. (Author's abstract)
W88-06838

FISH AND MACROCRUSTACEAN USE OF SUBMERGED PLANT BEDS IN TIDAL FRESHWATER MARSH CREEKS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
L. P. Rozas, and W. E. Odum.
Marine Ecology Progress Series MESEDT, Vol. 38, No. 2, p 101-108, June 18, 1987. 3 fig, 3 tab, 42 ref. Dept. of Commerce Grant NA81AA-D-00025.

Descriptors: *Tidal marshes, *Marshes, *Fish, *Crustaceans, Marsh plants, Freshwater creeks, Macrocrustaceans, Aquatic plants, Shrimp, Killifish, Sunfish, Crabs, Habitats.

Fishes and macrocrustaceans (nekton) were sampled biweekly from mid-June through October 1985 from submerged aquatic vegetation (SAV) and during September 1985 from unvegetated areas of tidal freshwater marsh creeks. Nineteen species of fishes (6918 individuals, 3.068 kilograms preserved weight) from 9 families, and 3 species of invertebrates (12036 individuals, 1.577 kilograms preserved wet weight) were collected from SAV. The most abundant species were grass shrimp Palaemonetes pugio, banded killifish Fundulus diaphanus, mummichogs F. heteroclitus, bluespotted sunfish Enneacanthus gloriosus, and mud crabs Rhithropanopeus harrisii. Recruitment of small juvenile fishes of several species coincided with the period of greatest SAV areal cover (late June through September). Average densities of fauna were significantly greater in SAV than over nearby unvegetated creek bottoms in September. Faunal abundance was not significantly related to SAV biomass, perhaps because the structural complexity of the SAV in the study was high and nekton were abundant when SAV was present at low densities (i.e, low biomass). The numerically dominant species that occurred in SAV at low tide and on the marsh surface at high tide were similar. Grass shrimp, banded killifish, mummichogs and bluespotted sunfish accounted for >90% of the total number of organisms collected in each of the 2 habitats, SAV and marsh surface. The SAV of tidal freshwater marsh creeks is probably most important as habitat for forage fishes. Young of recreational species such as bluegill Lepomis macrochirus and pumpkinseed L. gibbosus also occupy this habitat. (Author's abstract)
W88-06854

GRAZING OF CILIATED PROTOZOA ON FREE AND PARTICLE-ATTACHED BACTERIA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W88-06855

BENTHIC ENERGY FLOW DURING A SIMULATED AUTUMN BLOOM SEDIMENTATION,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2L.
W88-06857

HEAVY METAL ABUNDANCES IN THE KANDY LAKE-AN ENVIRONMENTAL CASE STUDY FROM SRI LANKA,
Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.
For primary bibliographic entry see Field 5B.
W88-06877

APPLICATION OF A CONTINUOUS DISTRIBUTION MODEL FOR PROTON BINDING BY HUMIC ACIDS EXTRACTED FROM ACIDIC LAKE SEDIMENTS,
For primary bibliographic entry see Field 5B.
W88-06882

SUSPENDED SEDIMENT TRANSPORT, SEDIMENTATION, AND RESUSPENSION IN LAKE HOUSTON, TEXAS: IMPLICATIONS FOR WATER QUALITY,
Rice Univ., Houston, TX. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W88-06883

TRACE ELEMENT DISTRIBUTION IN WATERS OF THE NORTHERN CATCHMENT AREA OF LAKE KINNERET, NORTHERN ISRAEL,
Geochemistry Division, Geological Survey of Israel, 30 Malkhe Israel Street, Jerusalem 95501, Israel.
For primary bibliographic entry see Field 5B.
W88-06884

TRACE METAL DYNAMICS IN A SEASONALLY ANOXIC LAKE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2K.
W88-06888

SEASONAL VARIATIONS IN THE LOOSELY SORBED PHOSPHORUS FRACTION OF THE SEDIMENT OF A SHALLOW AND HYPEREUTROPHIC LAKE,
Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 5B.
W88-06889

PHYTOPLANKTON OF A RECENTLY LANDLOCKED BRACKISH-WATER LAGOON OF LAKE TANGANYIKA: A SYSTEMATIC ACCOUNT,
Department of Biology, University of Burundi, BP 2700 Bujumbura, Burundi.
A. G. Caljon.
Hydrobiologia HYDRB8, Vol. 153, No. 1, p 31-54, October 9, 1987. 6 plates, 1 tab, 43 ref.

Descriptors: *Lakes, *Lagoons, *Phytoplankton, *Brackish water, *Algae, Saline water, Lake Tanganyika, Africa, Diatoms, Tropical zone, Marine algae, Chlorophyta, Euglenophyta, Cyanophyta, Taxonomy.

Five new taxa were among the 273 taxa observed in a systematic study of the phytoplankton of a recently landlocked lagoon of Lake Tanganyika. Salinity measurements varied from 1.906 to 9.821 g/liter at one sampling station, less at the other stations. The new taxa were Trachelomonas dubia Swir. emend. Defl. var. colliundulata Caljon, Tr. gatumbana Caljon, Tr. komarovii Skv. var bicollaris Caljon, Chroomonas angusta Caljon, and Scourfieldia chlorolateralis Caljon. Diatoms were qualitatively the most important group (37.7%, 103 taxa) followed by Chlorophyta (23.0%, 63 taxa), Euglenophyta (19.4%, 53 taxa), and Cyanophyta (13.6%, 37 taxa). Present in fewer numbers were Cryptophyta (2.9%, 8 taxa), Dinophyta (0.7%, 2 taxa), Chrysophyta (0.4%, 1 taxon), Xanthophyta (1.5%, 4 taxa), and Prasinophyta (0.7%, 2 taxa). Many typical brackish-water and marine algal taxa were observed. They were divided among cosmopolitan/subcosmopolitan (89%) and tropical/subtropical (11%). (See also W88-06893) (Cassar-PTT)
W88-06892

RECENTLY LANDLOCKED BRACKISH-WATER LAGOON OF LAKE TANGANYIKA: PHYSICAL AND CHEMICAL CHARACTERISTICS, AND SPATIO-TEMPORAL DISTRIBUTION OF PHYTOPLANKTON,
Department of Biology, University of Burundi, BP 2700 Bujumbura, Burundi.
A. G. Caljon.
Hydrobiologia HYDRB8, Vol. 153, No. 1, p 55-70, October 9, 1987. 14 fig, 2 tab, 39 ref.

Descriptors: *Lakes, *Lagoons, *Phytoplankton, *Brackish water, *Algae, *Lake Tanganyika, Saline water, Africa, Tropical zone, Seasonal variation, Spatial distribution, Water quality, Nutrients, cyanophyta, Euglenophyta, Eutrophication, Diatoms.

Monthly measurements of physical and chemical characteristics were made at two localities in the eastern part of a recently landlocked lagoon of Lake Tanganyika. Variables analyzed were temperature, pH, conductivity, sodium, potassium, magnesium, calcium, carbonate, bicarbonate, chloride, and sulfate. Large seasonal fluctuations of salinity were recorded (1.68-8.21 g/liter). The seasonal water input controlled algal seasonality mainly through its effect on salinity and indirectly through its influence on nutrient concentration by dissolution and dilution of the excrements of the numerous cattle and other organic matter. Phytoplankton was mainly composed of Cyanophyta and Euglenophyta. Euglenophyta dominated during the dry periods with high salinity and probably very high nutrient levels, while Cyanophyta preferred moderate salt and nutrient concentrations during the rainy periods. The phytoplanktonic community was composed of a large number of perennial and a reduced quantity of annual organisms. A spatial study of the recently landlocked lagoon revealed an ascending salinity gradient, principally due to a sodium bicarbonate/carbonate enrichment, between locations near the lake and more inland situated stations. These facts point to a lakewater supply and a salt concentration by evaporation in the swamps. Proportionally lower magnesium, calcium, and potassium values were recorded at high salinities due to chemical precipitation and biotic factors. A blue-green algal bloom was observed in the eastern water body (salinity: 4.64 g/liter); simultaneously an important development of diatoms dominated the western water body (salinity: 2.18 g/liter). No significant differences in morphometry, exposure, water temperature or nutrient levels (nitrate, nitrite, ammonia, orthophosphate) were observed. The relatively low salinity and high nutrient concentration in the western water body probably favored diatom development during the rainy season. The relatively higher salinity in the eastern water body during the rainy season was probably responsible for the dominance of blue-green algae through its negative influence on silica concentration and notwithstanding the high inorganic nitrogen concentration. (See also W88-06892) (Author's abstract)
W88-06893

REMOVAL OF FLOODWATER NITROGEN IN A CYPRESS SWAMP RECEIVING PRIMARY WASTEWATER EFFLUENT,
Central Florida Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5D.
W88-06894

FACTORS CONTROLLING PRIMARY PRODUCTION IN TWO DIVERTED RIVERS WITH A LARGE FLOW REDUCTION (FACTEURS CONTROLANT LA PRODUCTION PRIMAIRE DANS DEUX RIVIERES SOUMISES A UNE FORTE REDUCTION DE DEBIT),
Department of Biological Sciences, University of Quebec at Montreal, C.P. 8888, Succ. A, Montreal, Quebec.
For primary bibliographic entry see Field 6G.
W88-06895

PHYTOPLANKTON SUCCESSION IN THE SANYATI BASIN, LAKE KARIBA,
University Lake Kariba Research Station, P.O. Box 48, Kariba, Zimbabwe.
L. Ramberg.
Hydrobiologia HYDRB8, Vol. 153, No. 3, p 193-202, October 30, 1987. 4 fig, 4 tab, 34 ref.

Descriptors: *Lakes, *Data collections, *Phytoplankton, *Seasonal variation, Algae, Lake Kariba, Zimbabwe, Tropical regions, Reservoirs, Sanyati River, Zambezi River, Biomass, Chlorophyta, Cyanophyta, Cylindrospermopsis, Dinoflagellates, Synedra, Stratification, Thermal stratification, Destratification.

Phytoplankton succession was studied in Lake Kariba, a 25-year-old man-made lake on the Zambezi River, Zimbabwe. It is 320 km long, 40 km at maximum width, maximum depth of 120 m, and mean depth of 29.5 m, with normal variation of 2-3 m in average years and 6 m during the study

period. The surface water temperature is highest (29-30 C) in January-April during the hot wet season and declines to 23 C in July and August, when it overturns. The study covered 18 months starting in the rainy warm season of October 1982. The phytoplankton biomass had two maxima during the period. The first occurred during the rainy season, lasted for 3-4 months and comprised 70-90% of Cyanophyceae with Cylindrospermopsis raciborskii as the dominating species. Dinophyceae were sub-dominant during this season. The second maximum developed during lake turnover at the cool season, lasted 1-2 months, and was composed of Bacillariophyceae with a number of Synedra spp. dominating. The mean yearly biomass was 310 mg/cu m wet weight. Peaks in biomass were 750 mg/cu m in January-February 1982 and 1400 mg/cu m in January-February 1983. A total of 82 phytoplankton species were found during the study. The species composition of phytoplankton, the biomass, and the succession of Lake Kariba were similar to those of natural tropical lakes; however, the high proportion of blue-green species was unique. Possible explanations for this difference are the higher epilimnion temperature, more stable stratification, and a low inorganic nitrogen concentration. (Cassar-PTT)
W88-06897

TROPHIC STATUS OF TILITSO, A HIGH ALTITUDE HIMALAYAN LAKE,
National Inst. for Environmental Studies, Yatabe (Japan).
M. Aizaki, A. Terashima, H. Nakahara, T. Nishio, and Y. Ishida.
Hydrobiologia HYDRB8, Vol. 153, No. 3, p 217-224, October 30, 1987. 8 fig, 6 tab, 12 ref. Japan Ministry of Education, Science and Culture Grants No. 590941076 and No. 60043042.

Descriptors: *Limnology, *Lakes, *Data collections, *High altitude lakes, *Trophic level, *Glacial lakes, *Phytoplankton, Tilitso, Nepal, Oligotrophic lakes, Water quality, Chemical startification, Chlorophyll a, Photosynthesis.

Water quality and trophic status of Lake Tilitso in central Nepal were studied in September 1984. This lake is 4920 m above sea level with a surface area of 10.2 sq km and a maximum depth of 95 m. Most of the lake is deeper than 60 m. The southeast side is dammed by an end moraine while the west side is covered by glacier. Water temperature during the survey was 8 C on the surface. The euphotic layer was 5 m deep, reflecting the presence of glacial silt. Water quality parameters were as follows: pH, 8.3-9.2; electrical conductivity, 130-157 micro S/cm; dissolved oxygen, 5.4-6.0 mg/liter; total phosphorus, 2-6 microgram/liter (almost the detection level); dissolved total nitrogen, 0.10-0.22 mg/liter. Measurements of several cations showed chemical stratification, indicating little mixing during the summer. Chlorophyll a concentrations were 0.12-0.26 microgram/liter, with the epilimnion having higher values than the hypolimnion. Bacterial levels were extremely low, the highest only 120,000 cells/ml in the epilimnion. Phytoplankton biomass was very low; Cyclotella comensis dominated with 155 cells/ml at the 5-m depth. Scenedesmus sp. and Dicytochorella globosa were seen in very low densities. Daily photosynthetic production was estimated as 12.3 mg C/sq m/day. Zooplankton consisted of the copepod, Arctodiaptomus altissimus, (543 individuals/cu m) and a few rotifers, Hexarthra bulgarica nepalensis. No fish were collected in spite of efforts to do so. The lake was classified as ultraoligotrophic. (Cassar-PTT)
W88-06898

DISTRIBUTION OF BENTHIC INVERTEBRATES IN ACID, BROWN WATER STREAMS IN THE SOUTH ISLAND OF NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
M. J. Winterbourn, and K. J. Collier.
Hydrobiologia HYDRB8, Vol. 153, No. 3, p 277-286, October 30, 1987. 4 fig, 3 tab, 48 ref.

Descriptors: *Streams, *Data collections, *Acid streams, *Invertebrates, *Benthic fauna, Aquatic animals, Aquatic insects, Insects, Caddisflies, Mayflies, Elmids, Stoneflies, New Zealand, Organic carbon, Aluminum, Brown water, Humic acids, Fulvic acids.

Naturally acid streams (pH 3.5-8.1) in New Zealand were examined for relationships between benthic fauna and water quality parameters. These streams derived their acidity from high concentrations of humic acids and other natural substances, not from acid precipitation. pH was strongly correlated with alkalinity (0-49 g/cu m CaCO3) and less strongly with conductivity (2.0-9.7 mS/m). A strong positive correlation was found between dissolved organic carbon and total reactive aluminum concentration, both of which were negatively correlated with pH. Aluminum was probably in the nontoxic, organically complexed form. Benthic invertebrates were examined at 34 sites. Taxonomic richness was not correlated with pH, and similar numbers of ephemeropteran, pleocopteran, and trichopteran taxa were taken from the three groups of streams (pH <5.6, pH 5.6-6.9, and pH >6.9). Many species occurred over a wide pH range; the lower limit was about pH 4.5. The mayfly Deleatidium occurred at 33 of the sites and was among the most abundant taxa at 32 of them. Stoneflies (Zelandobius confusus, Austroperla cyrene, and Stenoperla maclellani), an elmid (Hydora sp.), and a caddisfly (Psilochorema sp.) also occurred in over half the streams and frequently were abundant. Few habitat specialists were found. Benthic assemblages were not associated strongly with measured physicochemical factors, but streams in close proximity tended to have similar faunas. This suggests that the availability of suitable colonizers sets the limits to species richness and is important in determining the composition of benthic assemblages at a particular locality. (Cassar-PTT)
W88-06901

CONTRIBUTION FROM NITROGEN FIXATION (ACETYLENE REDUCTION) TO THE NITROGEN BUDGET OF LAKE TOHOPEKALIGA (FLORIDA),
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
F. E. Dierberg, and M. M. Scheinkman.
Hydrobiologia HYDRB8, Vol. 154, p 61-73, November 16, 1987. 4 fig, 6 tab, 39 ref.

Descriptors: *Lakes, *Nitrogen fixation, *Limnology, *Eutrophic lakes, *Lake Tohopekaliga, Florida, Algae, Nutrients, Cyanophyta, Diurnal variation, Seasonal variation.

The acetylene reduction technique was used to assay nitrogen fixation in shallow, eutrophic Lake Tohopekaliga in central Florida during 1984. The diurnal pattern of nitrogen fixation was similar in central and south basins though the magnitudes varied. Beginning at sunrise, fixation rates for both the light- and dark-incubated samples increased along with the increasing light intensities. After reaching a maximum rate in late afternoon, fixation rates sharply decreased until 21:00, approaching zero by 06:00. Only 7% of the total nitrogen fixed in the surface water occurred between 22:00 and 07:00 at the central basin. Fixation increased at all depths in the lake with increasing light intensity beginning at 06:00. Most of the nitrogen fixation occurred from March to September. Ninety-four percent of the total fixation in the lake was found in the water column and was associated with the blue-green algae Anabaena spp. The nitrogen fixation for the year 1984 totaled 5.7 g N/sq m, 44% of the total nitrogen input to the lake and equivalent to 497 metric tons of nitrogen for the year. Components of the total amount of fixed nitrogen (in g N/sq m/yr) were as follows: euphotic zone during light period, 3.5; aphotic zone during light period, 1.4; water column during dark period, 0.5; and sediment, 0.3. (Cassar-PTT)
W88-06903

VERTICAL NUTRIENT TRANSPORT AND ITS EFFECTS ON EPILIMNETIC PHOSPHORUS IN FOUR CALCAREOUS LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Hydrobiologia HYDRB8, Vol. 154, p 87-102, November 16, 1987. 7 fig, 6 tab, 45 ref. EPA Research Grant No. 16010-EHR and Training Grant No. 5P2-WP-184-04.

Descriptors: *Eutrophic lakes, *Limnology, *Path of pollutants, *Lakes, *Phosphorus, *Nutrients, Mendota Lake, Delavan Lake, Green Lake, Fish Lake, Wisconsin, Stratification, Sediments, Lake sediments, Epilimnion, Mixing, Thermal stratification, Water temperature, Temperature, Vertical distribution, Wind effects, Water circulation.

The influence of vertical nutrient transport on epilimnetic phosphorus was studied comparatively in four calcareous Wisconsin lakes during 1972. In the two lakes with steep metalimnetic nutrient gradients (Mendota, Delavan), upward fluxes by entrainment and eddy diffusion exceeded all other influxes combined; here epilimnetic total-P concentrations increased during periods of high windpower and thermocline migration and decreased during comparatively stagnant intervals. In the two lakes lacking upper metalimnetic P gradients (Green, Fish), higher windpower had little or no effect on epilimnetic phosphorus. In each of the four lakes epilimnetic P declined in early summer until a quasi steady-state was achieved between P influxes and P sedimentation. In Mendota and Delavan steady-state featured higher concentrations of total-P and much higher epilimnetic concentrations of particulate-P and chlorophyll than in Green and Fish Lakes, mainly because of the high fluxes of molybdate-reactive, biologically-available P through the seasonal thermocline. The flux analysis illustrated why the mean lake total P concentration after ice-out was an inconsistent measure for estimating nutrient potential and chlorophyll standing crops during the following summer in stratified lakes. (Author's abstract)
W88-06904

MICRONUTRIENT AND PHOSPHORUS LIMITATION OF PHYTOPLANKTON ABUNDANCE IN GEM LAKE, SIERRA NEVADA, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-06905

PARTICULATE ORGANIC MATTER IN A MOUNTAIN STREAM IN THE SOUTH-WESTERN CAPE, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2E.
W88-06907

EFFECT OF AGRICULTURE ON THE PRIMARY PRODUCTION IN LAKE BESKIE (POLAND) AS RECORDED IN THE STRATIGRAPHY OF FOSSIL PIGMENTS,
Department of Ecology and Freshwater Biology, Academy of Agriculture and Teshnology, 10-957 Olsztyn, Poland.
For primary bibliographic entry see Field 5C.
W88-06910

DYNAMICS OF DISSOLVED ORGANIC NITROGEN IN SUBALPINE CASTLE LAKE, CALIFORNIA,
California Univ., Davis. Div. of Environmental Studies.
J. P. Zehr, S. G. Paulsen, R. P. Axler, and C. R. Goldman.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 33-45, January 8, 1988. 5 fig, 1 tab, 55 ref. National Science Foundation Grant No. BSR-8019918.

Descriptors: *Limnology, *Lakes, *Nitrogen, *Organic matter, *Alpine lakes, Castle Lake, California, Aquatic ecosystems, Ecosystems, Amino acids, Primary productivity, Productivity, Phytoplankton, Zooplankton, Chlorophyll, Algae, Biomass.

Dissolved organic nitrogen (DON) concentrations were measured in meso-oligotrophic Castle Lake, California, during the ice-free season in 1982, 1983,

and 1984. No consistent relationships were found between DON and particulate-N, primary productivity rates, or chlorophyll concentrations. However, increases in DON concentrations were observed in the early growing season of 1982 and 1984 when water temperature was rising and a diatom bloom was senescing. DON increased at a high rate (0.31 mg atom N/cu m/day) and then rapidly disappeared. Sediment release appeared to be the most important source of DON. Dissolved free amino acids were always < 7.5% of the DON pool and did not vary in the composition of specific amino acids during the growing season. (Author's abstract)
W88-06911

SOME LIMNOLOGICAL OBSERVATIONS ON TWO ETHIOPIAN HYDROELECTRIC RESERVOIRS: KOKA (SHEWA ADMINISTRATIVE DISTRICT) AND FINCHAA (WELEGA ADMINISTRATIVE DISTRICT),
Department of Biology, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia.
M. Mesfin, C. Tudorancea, and R. M. Baxter.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 47-55, January 8, 1988. 6 fig, 5 tab, 23 ref.

Descriptors: Limnology, *Lakes, *Reservoirs, *Dams, Koka Reservoir, Finchaa Reservoir, Ethiopia, Aquatic habitats, Habitats, Fish, Benthos, Water quality, Phytoplankton, Zooplankton.

Koka Reservoir in the Ethiopian Rift Valley (altitude 1600 m) is similar limnologically to natural lakes in the region. It was supersaturated with oxygen to a depth of about 8 m and showed pronounced conductivity stratification, probably caused by incomplete mixing of two inflows (Awash River and Mojo River). Phytoplankton was dominated by Microcystis. Zooplankton was of low diversity but abundant. There was a large population of benthic invertebrates, dominated by Nematoda, followed by Chironomidae and Ostrocoda. The small proportion of oligochaetes in the benthos compared with natural lakes in the region suggests that the ecosystem may not yet be fully mature. Sediment was very fine and contained no undecomposed material. The organic content was high, up to 11.53%. Finchaa Reservoir in west central Ethiopia (altitude 2200 m) was very different. Comprised of flooded swamps, it contained many floating islands and large quantities of decomposing vegetation, causing oxygen depletion even at the surface. The water was turbid because of organic debris, of low conductivity, slightly acidic, and calcium-dominated. Microcystis dominated the phytoplankton. Zooplankton were sparse and of very low diversity. Almost no benthic invertebrates were found. The sediment contained up to 42.3% organic matter, much of it decomposing roots and stalks. It is expected that high inputs of organic matter to this lake will continue because of growth along the banks during low water followed by immersion and decomposition. (Cassar-PTT)
W88-06912

FLUCTUATION OF ALGAL ALKALINE PHOSPHATASE ACTIVITY AND THE POSSIBLE MECHANISMS OF HYDROLYSIS OF DISSOLVED ORGANIC PHOSPHORUS IN LAKE BARATO,
Division of Water Environment, Hokkaido Research Institute for Environmental Pollution, Kita 19, Nishi 12, Kita-Ku, Sapporo 060, Japan.
S. Hino.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 77-84, January 8, 1988. 2 fig, 4 tab, 27 ref.

Descriptors: *Lakes, *Algae, *Phosphorus, *Alkaline phosphatase, *Enzymes, Lake Barato, Japan, Phytoplankton, Phosphates, Hydrolysis.

Fluctuation of algal alkaline phosphatase activity and the possible mechanisms of hydrolysis of dissolved organic phosphorus by alkaline phosphatases that could be isolated from algae were investigated seasonally at Lake Barato, Japan. The fluctuation of specific enzymatic activity was affected by algal species rather than by the concentration of external phosphorus and amount of phytoplankton. More than 74% of the organic phosphorus extracted from phytoplankton was hydrolyzed by the three variants of alkaline phosphatase purified from Melosira spp., Anabaena sp., and Escherichia coli. By contrast, the organic phosphorus in lake water and that extracted from sediment muds were only partially hydrolyzed (up to 32% and 20%, respectively) by the same enzymes. These results indicate that phytoplankton cannot utilize most of the dissolved organic phosphorus in the lake water and in the sediment muds through enzymatic hydrolysis by alkaline phosphatase in spite of the high levels of this enzyme in the organisms. (Author's abstract)
W88-06913

BIRCH LEAF PROCESSING AND ASSOCIATED MACROINVERTEBRATES IN AN ACIDIFIED LAKE SUBJECTED TO LIMING,
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 5G.
W88-06914

ZOOPLANKTON OF A SMALL TROPICAL RESERVOIR (SOLOMON DAM, NORTH QUEENSLAND),
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
For primary bibliographic entry see Field 5G.
W88-06915

GROWTH IN A FRESHWATER SNAIL UNDER LABORATORY CONDITIONS IN RELATION TO EUTROPHICATION,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
For primary bibliographic entry see Field 5C.
W88-06916

WATER HYACINTH PRODUCTIVITY AND DETRITUS ACCUMULATION.
K. K. Moorhead, K. R. Reddy, and D. A. Graetz.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 179-185, January 15, 1988. 3 fig, 3 tab, 12 ref.

Descriptors: *Lakes, *Eutrophic lakes, *Water hyacinth, *Detritus, *Productivity, *Nutrients, Macrophytes, Nitrogen, Fertilizers, Seasonal variation.

Water hyacinth (Eichhornia crassipes (Mart) solms) productivity and detritus accumulation were evaluated in eutrophic lake water with and without added nutrients (fertilized and control reservoirs, respectively). Seasonal changes in plant productivity and detritus accumulation were determined at monthly intervals for one year. Significant differences were observed in plant productivity between seasons and nutrient additions. Seasonal plant productivity ranged from 1.9 to 23.1 mg (dry weight) per ha for the fertilized reservoir and -0.2 to 10.2 mg per ha for the control reservoir. Detritus accumulation was not significantly different between seasons or nutrient additions. Seasonal N assimilation by plants ranged from 34 to 242 kg N per ha for plants in the fertilized reservoir and <0 to 104 kg N per ha for plants in the control reservoir. Annual net N recovered in detritus represented 21 and 28% of the totoal N removed by plants in the fertilized and control reservoirs, respectively. Net N loading to the reservoirs from detritus was 92 to 148 kg N per ha per year. (Author's abstract)
W88-06918

REDUCTION IN BIOAVAILABILITY OF ORGANIC CONTAMINANTS TO THE AMPHIPOD PONTOPOREIA HOYI BY DISSOLVED ORGANIC MATTER OF SEDIMENT INTERSTITIAL WATERS,
Great Lakes Environmental Research Laboratory, Ann Arbor, MI 48104.
For primary bibliographic entry see Field 5B.
W88-06922

REVERSIBLE PROCESS CONCEPT APPLIED TO THE ENVIRONMENTAL MANAGEMENT OF LARGE RIVER SYSTEMS,
UA CNRS 367 Laboratoire d'Ecologie des Eaux Douces, Universite Lyon 1, 69622 Villeurbanne Cedex, France.
C. Amoros, J. C. Rostan, G. Pautou, and J. Bravard.
Environmental Management EMNGDC, Vol. 11, No. 5, p 607-617, September 1987. 3 fig, 1 tab, 38 ref.

Descriptors: *Wetlands, *Alluvial plains, *Succession, Ecosystems, Erosion, Population dynamics, Aquatic habitats, Floodplains, Eutrophication, Rhone River, Ain River, France.

Wetland ecosystems occurring within alluvial floodplains change rapidly. Within the ecological successions, the life span of pioneer and transient stages may be measured in several years or decades depending on the respective influences of allogenic (water dynamics, erosion, and deposition) and autogenic developmental processes (population dynamics, eutrophication, and terrestrialization). Mechanisms that are responsible for the ecosystem changes and their importance to environmental management are described. Two case studies one involving the Rhone River and the other the Lower Ain River, both in France, exemplify reversible and irreversible successional processes in reference to different spatial and temporal scales. The standing-water ecosystems with low homeostasis may recover their previous status after human action on the allogenic processes. On the scale of a whole reach of the floodplain, erosion and deposition appear as reversible processes that regenerate the ecological successions. The concepts of stability and reversibility are discussed in relation to different spatiotemporal referential frameworks and different levels of integration. The reversible process concept is also considered with reference to the energy inputs into involved subsystems. To estimate the probability of ecosystem regeneration or the cost of restoration, a concept of 'degrees of reversibility' is proposed. (Freeman-PTT)
W88-06971

PRIMARY PRODUCER DYNAMICS ASSOCIATED WITH EVAPORATIVE CONCENTRATION IN A SHALLOW, EQUATORIAL SODA LAKE (LAKE ELMENTEITA, KENYA),
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack.
Hydrobiologia HYDRB8, Vol. 158, p 1-14, January 1988. 11 fig, 1 tab, 50 ref. NSF Grants GB8320X, GB33310, and BMS75-03491.

Descriptors: *Primary productivity, *Phytoplankton, *Limnology, *Photosynthesis, *Lake Elmenteita, *Evaporation, *Salinity, Species composition, Lakes, Algae, Africa, Rainfall, Kenya, Conductivity.

Lake Elmenteita (0 deg 27 min S, 36 deg 15 min E) lies on the floor of the rift valley at 1776 m above sea level in Kenya. As a consequence of lower than average rainfall, the mean depth decreased from 1.1 to 0.65 m during the study period (February 1973 to August 1974). The initiation of major biological changes coincided with a period of rapid evaporative concentration in 1973 (February to April) when the conductivity increased from 19.1 to 27.0 mmhmos/cm. Spirulina platensis, Spirulina laxissima and Anabaenopsis arnoldii decreased in abundance precipitously in parallel with large declines in chlorophyll a concentration and phytoplankton photosynthetic rates. Once the overall abundance of phytoplankton had declined and the transparency had increased, primary productivity by benthic algae increased significantly. Paradiaptomus africanus, the only copepod living in the lake, was abundant in February and March 1973, but was gone by May. Eight hypotheses to explain these changes are evaluated and converge on the suggestion that a rate of change of salinity greater than 5 mmhmos/cm per month and a salinity exceeding 25 mmhmos/cm cannot be tolerated by P. africanus and adversely effects the nitrogen fixer, A. arnoldii. Furthermore, the loss of P. africanus and oxygenation of the sediments by benthic algae reduce the rate of recycling of nutrients which

alters phytoplankton abundance and species composition. (Author's abstract)
W88-06975

NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN A TROPICAL MEROMICTIC SODA LAKE,
Dept. of Botany, Kenyatta Univ., P.O. Box 43844, Nairobi, Kenya.
S. G. Njuguna.
Hydrobiologia HYDRB8, Vol. 158, p 15-28, January 1988. 11 fig, 3 tab, 36 ref. National Council for Science and Technology, Kenya Grant NCST-SEC4400-47.

Descriptors: *Lake Sonachi, *Limnology, *Seasonal variation, *Phytoplankton, *Biomass, *Nitrogen, *Phosphorus, Nutrients, Limiting nutrients, Chlorophyll a, Alkaline water, Lakes, Africa.

Seasonal variation through one year in total nitrogen (TN), total phosphorus (TP), phytoplankton biomass, phytoplankton species composition and other environmental factors were examined in Lake Sonachi, a tropical meromictic soda lake in Africa. Mean concentrations of TN and TP were 11,000 micrograms N/L and 100 micrograms P/L, respectively. Maximum concentrations of TN and TP occurred in the monimolimnion. Phytoplankton biomass ranged from 350 to 1260 mg/cu m. Synechococcus bacillaris, a small coccoid cyanophyte, dominate the phytoplankton. The mean chlorophyll a concentration of 37 mg/cu m was a modest value when compared with those of other tropical soda lakes. High TN:TP ratios indicated phosphorus limitation in the lake. (Author's abstract)
W88-06976

CHEMICAL AND ALGAL RELATIONSHIPS IN A SALINITY SERIES OF ETHIOPIAN INLAND WATERS,
Limnology Lab., Univ. of Ulster, Magherafelt, Co. Derry, N. Ireland.
R. B. Wood, and J. F. Talling.
Hydrobiologia HYDRB8, Vol. 158, p 29-67, January 1988. 13 fig, 7 tab, 143 ref.

Descriptors: *Lakes, *Ethiopia, *Limnology, *Alkaline water, *Water chemistry, *Salinity, *Conductivity, Rainfall, Evaporation, Phytoplankton, Biomass, Photosynthesis, Nutrients.

Chemical data are presented for 28 lakes and numerous inflows, including original analyses for 15 lakes, in which total ionic concentration and electrical conductivity vary over 4 orders of magnitude. There are strong positive correlations between increasing salinity and the concentrations of Na(+), alkalinity and Cl(-). The last is used, in conjunction with other analyses of atmospheric precipitation, to estimate the marine and denudative contributions and the evaporative concentration factor, and to distinguish trends of ionic species during evaporative concentration. With several exceptions, affected by past penetration of sea water into the Danakil and L. Assal cryptodepressions, the most saline lakes are soda lakes with HCO3(-) + CO3(2-) and Na(+) predominant and Ca(2+) and Mg(2+) largely eliminated. Soluble reactive silicate and phosphate tend to increase in concentration along the salinity series, but the unknown dynamics of algal growth are likely to introduce variance. Concentrations in some lakes are extremely high, e.g. > 40 mg SiO2/L and > 1 mg PO4-P/L. Phytoplankters recorded from individual lakes are tabulated and where available the community biomass concentration as chlorophyll a is given. Lakes of high salinity-alkalinity are typically very productive in terms of phytoplankton biomass and photosynthetic rates (exceptions: the very deep L. Shala and the very saline L. Abhe), supported in part by relatively high concentrations of phosphorus and inorganic carbon. Many species are of restricted salinity-alkalinity range, being characteristic of waters where levels are low (e.g. desmids, Melosira spp.), intermediate (e.g. Planctonema lauterborni), or high (e.g. Spirulina platensis). Phytoflagellates are most strongly represented in waters with higher concentrations of the bivalent cations Ca(2+) and Mg(2+). The common cyanophyte Microcystis aeruginosa can tolerate a wide salinity range, here as elsewhere. (Author's abstract)
W88-06977

PHOTOSYNTHETIC ACTIVITY OF PHYTOPLANKTON AND ITS RELATION TO ENVIRONMENTAL FACTORS IN HYPERSALINE MONO LAKE, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
R. Jellison, and J. M. Melack.
Hydrobiologia HYDRB8, Vol. 158, p 69-88, January 1988. 8 fig, 5 tab, 60 ref.

Descriptors: *Limnology, *Salinity, *Mono Lake, *Photosynthesis, *Light quality, *Phytoplankton, *Primary productivity, Algae, Biomass, Seasonal variation, Mathematical studies, Nutrients, California, Lakes, Statistical analysis.

The photosynthetic activity of phytoplankton in hypersaline Mono Lake, California was measured over the three year period, 1983-1985. The maximum chlorophyll-specific rate of carbon uptake (P sub m to the B power) and the light-limited slope (alpha) were derived from laboratory measurements of photosynthesis vs. irradiance (P-I) relationships. Annual estimates of primary production were 340-540 g C/sq cm/yr. Production was two to three times higher during the spring of 1983 than in the springs of 1984 and 1985; higher standing biomass of algae occurred in 1983. While P sub m to the B power rates followed water temperatures and varied over 40-fold over the year, integral primary production varied less since periods of high P sub m to the B power occurred when algal biomass was low. Sixty-eight percent of the seasonal variation in the P sub m to the B power was explained by a regression on temperature (53%), chlorophyll a (12%), and the carbon:chlorophyll a ratio (3%). Light-saturated and light-limited rates of photosynthesis generally covaried, evidenced by the strong seasonal correlation between P sub m to the B power and alpha. There was no correlation of carbon uptake with ambient levels of inorganic nitrogen. The regression coefficient of the dependence of P sub m to the B power on the seasonal temperature trend was much larger than that determined from individual samples incubated at several different temperatures; this indicates that uptake is limited by more than low temperatures in the spring. Regression equations including only temperature, chlorophyll and depth were sufficient to estimate patterns of seasonal year to year variation in integral primary productivity. (Author's abstract)
W88-06978

MICROCOSM STUDY OF NITROGEN UTILIZATION IN THE GREAT SALT LAKE, UTAH,
Utah State Univ., Logan.
For primary bibliographic entry see Field 5C.
W88-06979

AQUATIC MACROPHYTES IN SALINE LAKES OF THE CANADIAN PRAIRIES,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer, and J. M. Heseltine.
Hydrobiologia HYDRB8, Vol. 158, p 101-116, January 1988. 8 fig, 5 tab, 46 ref. NSERC Grant A1412.

Descriptors: *Macrophytes, *Species composition, *Saline lakes, *Salinity, *Aquatic plants, *Limnology, Light quality, Salt tolerance, Angiosperms, Lakes, Plants, Prairies, Canada, Meromixis.

Vascular macrophyte species richness decreases with increasing salinity. Only three species of submerged plants (Potamogeton pectinatus, Ruppia maritima, R. occidentalis) tolerate hypersaline waters (> 50 g/L, total of ionic constituents). Eight emergent species occur in more saline habitats but only five (Scirpus maritimus var. paludosus, Distichlis stricta, Puccinellia nuttalliana, Scirpus americanus, Triglochin maritima) occur commonly over a range of saline lakes into the hypersaline category. Usually, species tolerant of high salinities are found over the entire saline spectrum and even extend into subsaline waters (<3 g/L) and thrive there. A major increase in the number of species occurs below 5 g/L. As the water recedes plants such as Salicornia rubra, Suaeda calceoliformes, Hordeum jubatum and Sonchus arvensis invade. Submerged angiosperm distribution is controlled by total ion concentration and substrate texture plays no apparent role. Although angiosperms normally grow in all kinds of substrates, they occupy coarse substrates in Wakaw Lake because suitable fine substrates are densely colonized by charophytes. In this lake light limited growth occurs to a depth of 5% of surface light. Light was not limiting in Redberry Lake but angiosperm growth was limited to the upper 8 m (10% or more of surface light). Thermal stratification and depth (pressure) were probably limiting instead. In meromictic Waldsea Lake the depth of the chemocline (6 m, 5% surface light) delimits angiosperm growth. (Author's abstract)
W88-06980

BENTHIC COMMUNITIES OF THE SALINE LAKES ABIJATA AND SHALA (ETHIOPIA),
Addis Ababa Univ. (Ethiopia).
C. Tudorancea, and A. D. Harrison.
Hydrobiologia HYDRB8, Vol. 158, p 117-123, January 1988. 3 fig, 5 tab, 11 ref.

Descriptors: *Limnology, *Saline lakes, *Benthic fauna, *Invertebrates, Lake Abijata, Lake Shala, Benthos, Ethiopia, Salt tolerance, Salinity, Lakes, Phytoplankton, Fish, Birds, Conductivity.

Lake Abijata lies in a shallow depression (maximum depth 8-9.5 m); the water is green with phytoplankton and it supports large fish and bird communities. Lake Shala lies in a deep caldera (maximum depth reputedly 260 m); phytoplankton is sparse and fish and bird communities scanty. Lakes Abijata and Shala, sampled in January, 1985, had conductivities of 14,000 and 21,000 microSiemens/cm at 25 deg C respectively, mainly due to high sodium, carbonate and chloride ions. Calcium concentrations are very low. The benthic fauna was studied with an Ekman grab to a depth of 8.5 m in Abijata and 15.5 m in Shala and was found to be dense in both lakes but varying greatly in composition at different depths. In Abijata the benthos consisted mainly of Ostracoda and Chironomidae, and in Shala mainly of Tubificidae, Ostracoda and Chironomidae. There were very few Nematoda. No true halophilic species were found but the community consisted of euryhaline forms found also in non-saline waters. Predatory invertebrates were absent and many of the dominant species, notably of the Chironomidae, were different from those of non-saline lakes nearby. (Author's abstract)
W88-06981

EFFECT OF LAKE LEVEL FLUCTUATIONS ON THE HABITATS OF BENTHIC INVERTEBRATES IN A SHALLOW TROPICAL LAKE,
Lake Chilwa Co-ordinated Research Project, Univ. of Malawi, P.O. Box 280, Zomba, Malawi, Central Africa.
M. A. Cantrell.
Hydrobiologia HYDRB8, Vol. 158, p 125-131, January 1988. 3 fig, 2 tab, 23 ref.

Descriptors: *Salt pans, *Saline lakes, *Water level fluctuations, *Limnology, *Benthic fauna, *Invertebrates, *Aquatic habitats, Biomass, Fish, Marshes, Flooding, Ecosystems, Africa, Lakes, Lake Chilwa.

Lake Chilwa, a large evaporation pan in Central Africa, is subject to seasonal and long-term fluctuations in water level. Several investigations on benthic invertebrates spanning an eleven year period are brought together to cover a complete hydrological cycle. The relative importance of various habitats for benthic invertebrates is considered from refilling of the lake after a dry phase through to exceptionally high lake levels when marsh outside a peripheral Typha swamp was flooded. Data collected during different phases of the cycle draw attention to the high invertebrate biomass of the marsh during periods of high lake

level. This unstable habitat supports 86% of the total invertebrate biomass of the lake. Fish production is also shown to be related to lake level and is significantly higher when the wide-spread flooding of the marsh occurs. The importance of this littoral zone in the functioning of the lake ecosystem is stressed. (Author's abstract)
W88-06982

EXPERIMENTAL EFFECTS OF ELEVATED SALINITY ON THREE BENTHIC INVERTEBRATES IN PYRAMID LAKE, NEVADA,
Arizona State Univ., Tempe. Dept. of Zoology.
D. L. Galat, M. Coleman, and R. Robinson.
Hydrobiologia HYDRB8, Vol. 158, p 133-144, January 1988. 4 fig, 1 tab, 41 ref.

Descriptors: *Pyramid lake, *Salinity, *Species composition, *Saline lakes, *Salt tolerance, *Bioassay, *Limnology, Benthic fauna, Invertebrates, Mortality, Sublethal effects, Food habits, Population exposure, Fish, Lakes.

Salinity of Pyramid Lake increased from 3.7 to 5.5 parts per thousand (ppt) between 1933 and 1980. Concern over future reductions in overall species richness prompted experiments to assess responses of dominant lake organisms to elevated salinity. Salinity tolerances of three important benthic invertebrates, Hyalella aztecta, Chironomus utahensis, and Heterocypris sp., were tested in controlled laboratory bioassays and also in a semi-natural; environment consisting of large (47 cu m) mesocosms. Densities of H. azteca in mesocosms were significantly lower at salinities of 8.0 and 11 ppt compared with 5.6 ppt controls in year one, but not in 8.5 ppt salinity mesocosms in year two. The 96-h LC50 for H. azteca was high at 19.5 ppt. Short-term mortalities of C. utahensis were 100% at salinities of 13.3 ppt and greater. Fifty-seven percent fewer larvae matured from third to fourth instar at 8.9 than at 5.5 ppt salinity in 17 day subacute bioassays. Furthermore, larval chironomid densities and emergence of adults from mesocosms were significantly reduced at salinities of 8.0 ppt and higher compared with controls. Mortality of Heterocypris sp. was 50% at a salinity of 18.6 ppt in laboratory bioassays and populations in mesocosms ranged between 40 and 100% lower at salinities of 8.0 and 11.0 ppt than in controls. Multiple generation mesocosm experiments indicated all three invertebrates were more sensitive to elevated salinity than results of short-term bioassays. The studies suggest populations of these invertebrates may be reduced from present levels if Pyramid Lake's salinity were to double, although none are expected to be extirpated. Food habit shifts and reduced production of lake fishes are likely consequences of salinity-induced disruption in the benthic invertebrate forage base. (Author's abstract)
W88-06983

COMPARATIVE POPULATION ECOLOGY OF EPHYDRA HIANS SAY (DIPTERA: EPHYDRIDAE) AT MONO LAKE (CALIFORNIA) AND ABERT LAKE (OREGON),
Dept of Zoology, Oregon State Univ., Corvallis, OR 97331.
D. B. Herbst.
Hydrobiologia HYDRB8, Vol. 158, p 145-166, January 1988. 18 fig, 4 tab, 38 ref.

Descriptors: *Mono Lake, *Abert Lake, *Salinity, *Saline lakes, *Population dynamics, *Limnology, *Ephydra, Aquatic habitats, Macroinvertebrates, Species composition, Biomass, Seasonal variation, Limiting nutrients, Water temperature, Lakes, California, Oregon.

The population dynamics of Ephydra hians Say final instar larvae and pupae were compared over a two year period in rocky littoral habitats of two alkaline saline lakes in the western Great Basin. Relative abundance increased from 1983 to 1984 at Mono Lake (California), during dilution from ca. 90 to 80 g/L TDS (total dissolved solids). In contrast, relative abundance decreased over the same period at Abert Lake (Oregon), accompanied by a dilution of salinity from ca. 30 to 20 g/L and a marked increase in the number and abundance of other benthic macroinvertebrate species. These observations are consistent with a hypothesis that proposes biotic interactions limit E. hians abundance at low salinity, and physiological stress limits abundance at high salinity. Oviposition extends from early spring to early fall. Mixed instars present throughout this period indicates multivoltine population dynamics with overlapping generations. The standing stock biomass of final instars increases exponentially in late spring and peaks in late summer or early fall. Pupae increase in proportional representation and abundance from a spring minimum to a fall maximum. The body size of adults and pupae cycle seasonally from a spring maximum to a fall minimum, and may be related to either or both food limitation, or water temperature. (Author's abstract)
W88-06984

ABUNDANCE AND SPATIAL DISTRIBUTION OF ARTEMIA SALINA IN LAKE ABERT, OREGON,
Dept. of Zoology, Oregon State Univ., Corvallis, OR 97331, USA.
F. P. Conte, and P. A. Conte.
Hydrobiologia HYDRB8, Vol. 158, p 167-172, January 1988. 2 fig, 3 tab, 10 ref.

Descriptors: *Saline lakes, *Lake Abert, *Limnology, *Spatial distribution, *Artemia, *Salinity, Population dynamics, Seasonal variation, Biomass, Shrimp, Lakes, Orgeon, Benthic flora, Algae.

In 1981-82 Abert Lake had an area of 200 sq km, with a mean depth of 2.5 m and a total dissolved salt concentration of 82 g/L. The spatial distribution and abundance of the brine shrimp, Artemia salina, were monitored for 1981-82. The 1981 during the midsummer months, with sampling primarily in the eastern side of Abert Lake, brine shrimp populations showed peak densities of 2-4 ind/L. In 1982, peak abundance occurred in early July and ranged between 5-8 ind/L. Lakewide estimates of brine shrimp derived from 14 collecting stations and assuming a uniform distribution over the lake resulted in estimates of lakewide abundance. The major algal species in the lake was a benthic filamentous green alga (Ctenocladus circinnatus). (Author's abstract)
W88-06985

NEARSHORE AND PELAGIC ABUNDANCES OF ARTEMIA MONICA IN MONO LAKE, CALIFORNIA,
Dircon Consultants, P.O. Box 515, Corvallis, OR 97339, USA.
F. P. Conte, R. S. Jellison, and G. L. Starrett.
Hydrobiologia HYDRB8, Vol. 158, p 173-181, January 1988. 3 fig, 4 tab, 25 ref.

Descriptors: *Mono Lake, *Limnology, *Spatial distribution, *Saline lakes, *Artemia, *Seasonal variation, Population dynamics, Shrimp, Biomass, Lakes, California.

The spatial distribution and abundance of the brine shrimp, Artemia monica, in Mono Lake, California were determined during 1982 and 1983. Peak abundances of shrimp occur in midsummer and reach densities of 15-17 individuals/L in the nearshore regions and 6-8 individuals/L in the pelagic region. The brine shrimp were non-uniformly distributed both vertically and horizontally. The coefficient of variation of shrimp abundance among stations within the nearshore region was similar to that found in the pelagic region. On two of the nine dates, nearshore densities were 3 to 4 times greater than those in the pelagic zone, and on average the brine shrimp appear to be slightly over-dispersed to the nearshore region. However, including nearshore abundance in lakewide estimates will usually result in a change of less than a 10%. (Author's abstract)
W88-06986

IN SITU HATCHING OF ARTEMIA MONICA CYSTS IN HYPERSALINE MONO LAKE, CALIFORNIA,
California Univ., Santa Barbara. Marine Science Inst.
G. L. Dana, C. J. Foley, G. L. Starrett, W. M. Perry, and J. M. Melack.
Hydrobiologia HYDRB8, Vol. 158, p 183-190, January 1988. 2 fig, 3 tab, 19 ref.

Descriptors: *Saline lakes, *Mono Lake, *Limnology, *Artemia, *Emergence traps, *Reproduction, Seasonal variation, Hatching, Population dynamics, Salinity, Lakes, California.

Two emergence trap designs were tested in Mono Lake, California, to measure in situ hatching of Artemia monica cysts on the lake bottom. One design in incorporated a removable sample bottle; the other had a catch tube which was pumped from the surface. Both traps rested on the bottom and had a narrow gap between the collecting funnel and bottom flange to allow the chemical conditions within the trap to be similar to those outside. This gap was open during April and May but, because some animals entered from outside the area enclosed by the trap, the gap was covered with 400 micron or 800 micron screen during June and July. The two trap types without screens sampled a station in oxic water 7 m deep similarly in April and May 1985. Mean daily hatching rates from April to May 1985 ranged from 720 to 25,340 shrimp sq m/day. In contrast, mean daily hatching rates during the same period at a station in anoxic water 21 m deep were from 3 to 138 shrimp sq m/day. June and July hatching rates in the shallow station were lower than in the spring, usually less than 1000 shrimp sq m/day. (Author's abstract)
W88-06987

ACID BRINE SHRIMP: METABOLIC STRATEGIES IN OSMOTIC AND IONIC ADAPTATION,
Dept. of Zoology, Oregon State Univ., Corvallis, OR 97331, USA.
F. P. Conte, and M. C. Geddes.
Hydrobiologia HYDRB8, Vol. 158, p 191-200, January 1988. 3 fig, 6 tab.

Descriptors: *Acid salt lakes, *Metabolism, *Saline lakes, *Adaptation, *Limnology, *Osmotic pressure, *Salt tolerance, *Brine shrimp, *Hydrogen ion concentration, Survival, Enzymes, Lakes, Ions, Adenosine triphosphate, Carbon dioxide, Australia.

Acid salt lakes are found in several regions of Australia but are uncommonly abundant in the Yilgarn Block area of southwestern Australia. The chemical properties of the acid salt lakes are in general similar to those of shallow ephemeral alkaline salt lakes found in adjacent regions except for having a higher hydrogen ion concentration and an absence of carbonate and bicarbonate ions. The Australian brine shrimp, Paratemia, is the major zooplankter living in these salt lakes. Present investigation on two species of larval Parartemia reveal P. zietziana nauplii having high salt tolerance (LD50>225 parts per thousand (ppt) TDS) but a narrow pH range with an optimum lying near pH 8. In contrast, P. contracta collected from acid salt lakes had a more restricted salt tolerance (LD50<100 ppt TDS) but a wider range of pH tolerances with substantial survival below pH 3.5. Both species, P. zietziana and contracta, when placed in ouabain-laden salines, demonstrated decreased survival and indirectly indicated the presence of a ouabain-sensitive sodium pump. Direct enzymatic assay of the sodium (Na, K-ATPase) in nauplii of P. zietziana gave specific activity values of 2.9 micron Pi/hr/mg protein supporting the working hypothesis that the nauplii of Parartemia have an osmoregulatory system similar to that found in larval Artemia which is dependent upon having large quantities of ATP to support the sodium pump. In Artemia larvae, the production of ATP is enhanced through a facultative pathway involving an aerobic gylcolysis linked C-4 dicarboxylic shunt. The major CO2 source for the C-4 acid shunt for alkaline brine shrimp has been found to be the dissolved bicarbonate/carbonate ions. In highly acidic saline lakes, these ions are missing. If acid brine shrimp are to survive in low pH ephemeral saline lakes, they must have evolved an additional proton pump and devised a mechanism to produce ATP from endogenous CO2 substrates. (Author's abstract)

W88-06988

ARTEMIA HABITATS: ION CONCENTRATIONS TOLERATED BY ONE SUPERSPECIES,
San Francisco State Univ., CA. Dept. of Biological Sciences.
S. T. Bowen, M. R. Buoncristiani, and J. R. Carl.
Hydrobiologia HYDRB8, Vol. 158, p 201-214, January 1988. 7 tab, 52 ref. NSF Grant BSR-82-00260.

Descriptors: *Artemia, *Salt tolerance, *Saline lakes, *Calcium, *Potassium, *Magnesium, *Carbonates, *Sulfates, *Chloride, *Population exposure, *Salinity, *Limnology, *Aquatic habitats, Survival, Reproduction, Lakes, Nauplii, Ions.

The geographic distribution, history, and ionic composition of habitats of Artemia franciscana are reviewed with emphasis on habitats with extreme values for ionic concentrations or ionic ratios: (a) high-chloride waters (sea water salterns and Zuni and Great Salt Lakes); (b) high-sulfate lakes in Saskatchewan (Chaplin and Little Manitou) and on the Okanogan plateau of Washington (Penley Lake complex); and (c) high-carbonate habitats in Nevada (Fallon), in California (Mono Lake) and in the Nebraska sandhills (Jesse and Antioch). First-instar nauplii from populations representative of each of these three habitat clusters were tested for tolerance of potassium (0-5 K/L, magnesium (0-1.3 g Mg/L), and calcium (0-0.6g Ca/L). Viabilities were recorded until survivors reached adulthood in pairs of simple defined synthetic culture media which differed in only one parameter. Eight populations showed four levels of tolerance of high potassium. Of four populations tested, all had high viability and fertility in media lacking potassium (above the level in the yeast diet). Artemia from sea water salterns or from Zuni, Chaplin, or Great Salt Lakes could not tolerate low levels of calcium (<20 mg/L). This accounts for their inability to tolerate hypersaline high-carbonate waters. Mono and Fallon nauplii had high viability and fertility in media with low levels of calcium (0-10 mg/L) but lacking magnesium. They could not survive for seven days, however, in low-calcium (<10 mg/L) media that contained moderate amounts of magnesium (1.3 g/L), indicating that magnesium interferes with utilization of low levels of calcium. For each of the three cations, the range of concentrations encountered by each population in the habitat is narrower than the range affording high viability in laboratory media. As expected, the midpoints of the two ranges are sometimes similar. In many cases, however, the narrower range of ionic concentrations reported for lake water is at the end of the range affording high viability in the laboratory. (Author's abstract)
W88-06989

FACTORS INFLUENCING SPECIES DIVERSITY IN SALINE WATERS OF DEATH VALLEY, USA,
Massachusetts Audubon Society, Lincoln.
E. A. Colburn.
Hydrobiologia HYDRB8, Vol. 158, p 215-226, January 1988. 3 fig, 4 tab, 57 ref. Univ. of Wisconsin Graduate School Research Committee Grant 100654 and NSF Grant DEB78-01288.

Descriptors: *Death Valley, *Limnology, *Saline water, *Species composition, *Salinity, *Macroinvertebrates, Aquatic habitats, Predation, California.

Salinity is a major factor influencing the distributions and abundances of aquatic macroinvertebrates of saline waters in Death Valley, California. This study included low salinity pools and channels in extensive marshes led by permanent or brackish springs, moderately saline streams and marshes, and highly saline streams and pools. A general pattern of declining numbers of species with increasing salinity is seen in Death Valley waters. Some species are restricted to low salinities, others are found only in highly saline pools, and still others are widely distributed over a broad range of salinities. Salinity alone cannot explain distributions seen in the field. Distributions and abundances of species such as the caddisfly Limnephilus assimilis Banks are broader than would be predicted on the basis of laboratory studies of salinity and temperature. Evidence is presented that for such species, biotic factors such as reduced predation at high salinities may compensate for increased physiological stress. (Alexander-PTT)
W88-06990

BIOGEOGRAPHICAL AFFINITIES OF THE FAUNA IN EPISODICALLY FILLED SALT LAKES: A STUDY OF LAKE EYRE SOUTH, AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams, and M. J. Kokkinn.
Hydrobiologia HYDRB8, Vol. 158, p 227-236, January 1988. 6 fig, 2 tab, 17 ref.

Descriptors: *Lake Eyre South, *Limnology, *Salt lakes, *Salinity, *Species composition, Salt tolerance, Macroinvertebrates, Lakes, Australia.

Lake Eyre South, a large and normally dry playa in central Australia, filled with water in January 1984 after an unusually heavy rain. Water persisted until January 1985. Salinity rose between these dates from 25o/oo to >270o/oo. Monthly observations on the fauna were made to determine if it consisted of widely dispersed species, and thus to test the assumption that episodically filled salt lakes are unimportant as evolutionary loci for the fauna of salt lakes. It was concluded that most species in the lake were indeed widely dispersed. Particularly common components of the fauna were: Craterocephalus eyresii (Steindachner) (fish), an undescribed species of Diacypris (ostracod), Moina baylyi Forro (cladoceran), Tanytarsus barbitarsis Freeman (chironomid), Parartemia minuta Geddes (anostracan), and Microcyclops platypus (Kiefer) (copepod). (Author's abstract)
W88-06991

SPANISH SALT LAKES: THEIR CHEMISTRY AND BIOTA,
Dept. of Ecology, Univ. of Barcelona, Diagonal 645, 08028 Barcelona, Spain.
F. A. Comin, and M. Alonso.
Hydrobiologia HYDRB8, Vol. 158, p 237-245, January 1988. 5 fig, 70 ref.

Descriptors: *Spain, *Salt lakes, *Salinity, *Limnology, *Species composition, Aquatic habitats, Macroinvertebrates, Lakes.

A large number of small saline lakes are distributed throughout Spain. Four main lake districts occur from sea level to 1000 meters above sea level. Most lakes are temporary because of the arid conditions in the Spanish endorheic areas. Many lakes are situated in Tertiary depressions in NE. and S. Spain. Lake basins were formed in karstic areas by hydrologic and aeolian erosion. Saline lakes in NE. Spain occupy areas isolated between river basins. The major ions encountered in these lakes are usually sodium-chloride and magnesium-sulfate; sodium carbonate or sodium-sulfate rich waters also occur. The biota of Spanish salt lakes is related to that of a larger biogeographical region which includes the Mediterranean countries. The main types of salt lakes in Spain include: (1) temporarily mineralized but not highly saline lakes, salinity is < 7 g/L. Chara canescens, C. aspera, Zanichellia palustris, Daphnia atkinsoni, Mixodiaptomus incrassatus and Arctodiaptomus wierzejskii are the most characteristic organisms. (2) Temporary salt lakes, salinity fluctuates between 7 and 300 g/L. Chara galioides, Lamprothamnion papulosum, Daphnia mediterranea, Arctodiaptomus salinus and Cletocamptus retrogressus are the most common species. (3) Permanent salt lakes, Ruppia maritima, Najas marina and Artemia salina are the characteristic organisms. (Author's abstract)
W88-06992

INSTANCE OF THERMAL INSTABILITY IN LAKE SIMBI, KENYA,
Kenya Marine and Fisheries Research Inst., Kisumu Lab., P.O. Box 1881, Kisumu, Kenya.
P. B. O. Ochumba, and D. I. Kibaara.
Hydrobiologia HYDRB8, Vol. 158, p 247-252, January 1988. 7 fig, 1 tab, 4 ref.

Descriptors: *Lake Simbi, *Light quality, *Alkaline water, *Seasonal variation, *Limnology, *Salt lakes, *Water temperature, Rainfall, Lakes, Kenya.

The vertical variations of temperature, dissolved oxygen, light, conductivity and alkalinity for July and August, 1985, were investigated. Water temperature was measured with a Fluke 77 multimeter and thermistor readable to 0.02 deg C. In July and August, 1985, saline Lake Simbi (Kenya) had a strong chemocline in the upper 4 meters and a pronounced cool layer (24.6-25.2 deg C) at 2.5 m depth lying above a slightly warmer layer. Rainfall, spring inflows and nocturnal cooling are suggested as responsible for the low temperatures in the upper warm column. To evaluate the possible importance of rainfall, springs and nocturnal cooling as sources of cool water to Lake Simbi requires data on the rain temperature, volumetric contribution of the springs, horizontal temperature transects and diel temperature profiles. (Alexander-PTT)
W88-06993

THERMAL STRATIFICATION AND THE STABILITY OF MEROMIXIS IN THE PRETORIA SALT PAN, SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
P. J. Ashton, and F. R. Schoeman.
Hydrobiologia HYDRB8, Vol. 158, p 253-265, January 1988. 12 fig, 3 tab, 18 ref.

Descriptors: *Thermal stratification, *Salt lakes, *Limnology, *Pretoria salt pan, *Salinity, *Water temperature, Lakes, Meromictic lakes, South Africa, Seasonal variation.

The Pretoria Salt Pan, South Africa, a small (0.076 sq km), shallow (Z sub max = 2.85 m), hypersaline, Maar Lake, lies within a clearly-defined crater and is fed by a perennial, slightly saline (3 g/L) artesian spring. The lake has two distinct solar-heated peaks in its temperature profile, each of these peaks located in a highly turbid (>80JTU) layer below a steep chemocline. The upper thermal peak, located at a depth of 10 cm, was transient, with a distinct diel pattern of diurnal heating and nocturnal cooling. The lower thermal peak, located below a steep chemocline and centered at approximately 60 cm, was stable and showed a seasonal pattern of winter heating (maximum: 38.5 deg C) and summer cooling (minimum: 27.4 deg C). The unusual bathymetry of the lake, combined with the sheltering effect of the crater rim and steep salinity gradient between the surface (30-80 g/L) and bottom water (280-310 g/L) prevented wind mixing of surface waters beyond a depth of approximately 50 cm. During a 28 month study all water deeper than 55 cm remained anaerobic, and the lake appeared to be meromictic. (Author's abstract)
W88-06994

LAKE TORRENS BRINE,
Univ. of Zambia School of Mines, P.O. Box 32376, Lusaka, Zambia.
R. M. Schmid.
Hydrobiologia HYDRB8, Vol. 158, p 267-269, January 1988. 2 fig, 1 tab, 9 ref.

Descriptors: *Lake Torrens, *Isotope studies, *Evaporation, *Salinity, *Limnology, Catchment areas, Playas, Seawater, Lakes.

Lake Torrens is an internal drainage basin. From the margin of the playa towards its center higher chloride values in the capillary zone coincide with increasing evaporation determined by deuterium values. After correcting for global deuterium variations the increased deuterium values indicate higher evaporation. The brine chemistry for a location near the center of the playa is given. The composition over time stays within one standard deviation of the mean concentration of the brine. NaCl is near saturation; the low Ca content is attributed to the precipitation of gypsum on the playa. To explain the Lake Torrens brine composition by direct evaporation from seawater, a marked deficiency of Br is evident. The deficiency

of this conservative element rules out the direct influence of seawater. Additionally, stratigraphic evidence indicates that Lake Torrens has never been invaded by the sea. (Alexander-PTT)
W88-06995

DISTRIBUTION, STRUCTURE, AND COMPOSITION OF FRESHWATER ICE DEPOSITS IN BOLIVIAN SALT LAKES,
San Diego State Univ., CA. Dept. of Biology.
For primary bibliographic entry see Field 2C.
W88-06996

AQUATIC NITROGEN TRANSFORMATIONS AT LOW OXYGEN CONCENTRATIONS,
Taupo Research Lab., Dept. of Scientific and Industrial Research, P.O. Box 415, Taupo, New Zealand.
M. T. Downes.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 172-175, January 1988. 3 fig, 29 ref.

Descriptors: *Limnology, *Nitrites, *Nitrates, *Lake Rotoiti, *Anoxic conditions, *Nitrification, Bacterial physiology, Nitrogen, Dissolved oxygen, Denitrification.

Nitrite and nitrous oxide made up 40% of the hypolimnetic dissolved inorganic nitrogen in mesotrophic Lake Rotoiti, New Zealand, prior to hypolimnetic anoxia. Up to 120 mg of N/cu m as nitrite and 20 mg of N/cu m as nitrous oxide accumulated, whereas dissolved-oxygen concentrations remained between 1.0 and 0.2 g/cu m and were totally consumed when the hypolimnion became completely anoxic. Assays of water column nitrification potentials, together with measurements of the relative rates of nitrate and nitrite reduction, suggested that at low dissolved oxygen concentrations both nitrite and nitrous oxide were produced mainly by ammonium-oxidizing bacteria, with nitrous oxide being a product of nitrifier denitrification. (Author's abstract)
W88-07002

EFFECT OF 5-FLUORO-2'-DEOXYURIDINE ON (3H)THYMIDINE INCORPORATION BY BACTERIOPLANKTON IN THE WATERS OF SOUTHWEST FLORIDA,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W88-07006

PREDICTION OF SUBSTRATE REMOVAL RATES OF ATTACHED MICROORGANISMS AND OF RELATIVE CONTRIBUTIONS OF ATTACHED AND SUSPENDED COMMUNITIES AT FIELD SITES,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W88-07009

ISOLATION OF FECAL COLIFORMS FROM PRISTINE SITES IN A TROPICAL RAIN FOREST,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
S. C. Rivera, T. C. Hazen, and G. A. Toranzos.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 513-517, February 1988. 1 fig, 2 tab, 21 ref. Sea Grant R/LR-08-87-THA1; Public Health Service Grants RR-2657 and RR-8102.

Descriptors: *Analytical methods, *Bioindicators, *Coliforms, *Rain forests, *Pollutant identification, *Escherichia coli, Microorganisms, Microbiological studies, Water quality, Leaves, Feces.

Samples collected from water accumulated in leaf axilae of bromeliads (epiphytic flora) in a tropical rain forest were found to harbor fecal coliforms. Random identification of fecal coliform-positive isolates demonstrated the presence of Escherichia coli. This bacterium was also isolated from bromeliad leaf surfaces. These data indicate that E. coli may be part of the phyllosphere microflora and not simply a transient bacterium of this habitat. The isolation of fecal coliforms from these sites was unexpected and raises questions as to the validity of using fecal coliforms as indicators of biological water quality in the tropics. (Author's abstract)
W88-07013

INFLUENCE OF PH ON MICROBIAL HYDROGEN METABOLISM IN DIVERSE SEDIMENTARY ECOSYSTEMS,
Wisconsin Univ., Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 5C.
W88-07015

PRIMARY AND BACTERIAL SECONDARY PRODUCTION IN A SOUTHWESTERN RESERVOIR,
Texas Univ. at Arlington. Dept. of Biology.
T. H. Chrzanowski, and J. G. Hubbard.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 661-669, March 1988. 8 fig, 2 tab, 41 ref.

Descriptors: *Primary productivity, *Limnology, *Reservoirs, *Lake Arlington, *Seasonal variation, *Bacterial production, Bacterial physiology, Carbon radioisotopes, Microorganisms, Microbiological studies, Lakes, Texas.

Rates of primary and bacterial secondary production in Lake Arlington, Texas, were determined. The lake is a warm (annual temperature range, 7 to 32 deg C), shallow, monomictic reservoir with limited macrophyte development in the littoral zone. Samples were collected from six depths within the photic zone from a site located over the deepest portion of the lake. Primary production and bacterial production were calculated from NaH14CO3 and (methyl-3H)thymidine incorporation, respectively. Peak instantaneous production ranged between 14.8 and 220.5 micrograms C/L/hr. There were two distinct periods of high rates of production. From May through July, production near the metalimnion exceeded 100 micrograms C/L/hr. During holomixis, production throughout the water column was 100 micrograms C/L/hr and > 150 micrograms C/L/hr near the surface. Annual areal primary production was 588 g C/sq m. Bacterial production was markedly seasonal. Growth rates during late fall through spring were typically around 0.002/hr, and production rates were typically 5 micrograms C/L/hr. Growth rates were higher during warmer parts of the year and reached 0.03/h by August. The maximum instantaneous rate of bacterial production was approximately 45 micrograms C/L/hr. Annual areal bacterial production was 125 g C/sq m. Temporal and spatial distributions of bacterial numbers and activities coincided with temporal and spatial distributions of primary production. Areal primary and bacterial secondary production were highly correlated ($r = 0.77$, $n = 15$, $P < 0.002$). (Author's abstract)
W88-07019

SEASONAL AND DIEL VARIABILITY IN DISSOLVED DNA AND IN MICROBIAL BIOMASS AND ACTIVITY IN A SUBTROPICAL ESTUARY,
University of South Florida, St. Petersburg. Dept. of Marine Science.
J. H. Paul, M. F. DeFlaun, W. H. Jeffrey, and A. W. David.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 718-727, March 1988. 10 fig, 4 tab, 41 ref. NSF Awards OCE-8415605 and BSR-8507343.

Descriptors: *Estuaries, *DNA, *Limnology, *Tampa Bay, *Biomass, *Salinity, *Seasonal variation, *Microbiological studies, Microorganisms, Isotope studies, Phytoplankton, Primary productivity, Bacteria, Organic carbon, Phosphorus, Diurnal variation.

Dissolved DNA and microbial biomass and activity parameters were measured over a 15-month period at three stations along a salinity gradient in Tampa Bay, Fla. Dissolved DNA showed seasonal variation, with minimal values in December and January and maximal values in summer months (July and August). This pattern of seasonal variation followed that of particulate DNA and water temperature and did not correlate with bacterioplankton (direct counts and (3H)thymidine incorporation) or phytoplankton (chlorophyll a and 14CO2 fixation) biomass and activity. Microautotrophic populations showed maxima in the spring and fall, heterotrophic microbial activity was greatest at the high estuarine (low salinity) station and lowest at the mouth of the bay (high salinity station), irrespective of season. Dissolved DNA carbon and phosphorus constituted 0.11 + or - 0.05% of the dissolved organic carbon and 6.6 + or - 6.5% of the dissolved organic phosphorus, respectively. Strong diel periodicity was noted in dissolved DNA and in microbial activity in Bayboro Harbor during the dry season. A noon maximum in primary productivity was followed by an 8 p.m. maximum in heterotrophic activity and a midnight maximum in dissolved DNA. This diel periodicity was less pronounced in the wet season, when microbial parameters were strongly influenced by episodic inputs of freshwater. These results suggest that seasonal and diel production of dissolved DNA is driven by primary production, either through direct DNA release by phytoplankton, or more likely, through growth of bacterioplankton on phytoplankton exudates, followed by excretion and lysis. (Author's abstract)
W88-07021

MICROBIAL DECOMPOSITION IN AQUATIC ENVIRONMENTS: COMBINED PROCESS OF EXTRACELLULAR ENZYME ACTIVITY AND SUBSTRATE UPTAKE,
Institut fur Meereskunde, Dusternbrooker Weg 20, D-2300 Kiel, Federal Republic of Germany.
For primary bibliographic entry see Field 5B.
W88-07023

SOUTH CAROLINA'S DIKED TIDAL WETLANDS: THE PERSISTING DILEMMAS,
South Carolina Univ., Columbia. Dept. of Government and International Studies.
For primary bibliographic entry see Field 5G.
W88-07054

USE OF ECHOSOUNDER TRACINGS TO ESTIMATE THE ABOVEGROUND BIOMASS OF SUBMERGED PLANTS IN LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 7B.
W88-07078

HIGHLY SPECIALIZED NITROGEN METABOLISM IN A FRESHWATER PHYTOPLANKTER, CHRYSOCHROMULINA BREVITURRITA,
University of Western Ontario, London. Dept. of Plant Sciences.
J. D. Wehr, L. M. Brown, and K. O'Grady.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 4, p 736-742, April 1987. 5 fig, 2 tab, 40 ref.

Descriptors: *Nitrogen metabolism, *Phytoplankton, *Plant physiology, *Metabolism, *Nitrogen compounds, *Lakes, *Acid rain, Cinder Lake, Lake 302-South, Ontario, Ammonium, Cations, Anions, Plant growth, Hydrogen ion concentration, Algae.

A field and laboratory culture study was carried out on the nitrogen metabolism of isolates of the freshwater phytoplankter Chrysochromulina breviturrita Nich. (Prymnesiophyceae). These were isolated from two different softwater lakes, one believed to be influenced by acidic precipitation (Cinder Lake) and another which was experimentally acidified with H2SO4 (Lake 302-South). The alga was able to utilize only NH4(+) as an inorganic N source. A range of irradiances and molybdenum concentrations failed to induce NO3(-) utilization. Among 17 organic N compounds including amino acids, purines, and other amines, only urea plus Ni(2+) as a cofactor would serve as the sole

N source for this species. Nonetheless, growth rates in media supplied with urea were significantly less than with NH4(+). Field data from Lake 302-S indicate that a predominance of NH4(+) versus NO3(-) as the major inorganic N species may have favored the development of a Chrysochromulina-dominated community during August 1984. A detailed depth profile also indicated that a metalimnetic peak (>20,000,000 cells/liter) of this alga coincided with a distinct NH4(+) depletion, which occurred at no other time during the year. Experiments with isolates of C. breviturrita and a Nannochloris sp. (Chlorophyceae) (approximately 1 micrometer in diameter) from this community indicated that the former alga possessed a highly specialized N metabolism much like the Cinder Lake isolate. The Nannochloris sp. from the same environment grew on NO3(-) and NH4(+) equally well. It is suggested that the specialized NH4(+) utilization by C. breviturrita may itself influence the pH regime of poorly buffered waters through selective NH4(+) uptake and H(+) generation. (Author's abstract)
W88-07079

NITRIFICATION: A SIGNIFICANT CAUSE OF OXYGEN DEPLETION UNDER WINTER ICE,
Department of Microbiology, Macdonald College of McGill University, 21 222 Lakeshore Road, Ste Anne de Bellevue, Que. H9X 1C0.
R. Knowles, and D. R. S. Lean.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 4, p 743-749, April 1987. 4 fig, 4 tab, 31 ref.

Descriptors: *Nitrification, *Oxygen depletion, *Lakes, *Ice, Iced lakes, Depletion, Ammonium, Nitrogen compounds, Nitrates, Nitrites, Oxygen, Lake Saint George, Ontario, Isotopic tracers, Bacteria, Oxygen requirements, Fish, Winter, Kill.

Changes in concentrations of ammonium, nitrite, nitrate, and oxygen suggested the occurrence of significant nitrification throughout the water column of mesotrophic Lake St. George, Ontario, during the winter months from 1976 to 1984. The existence of nitrapyrin- and acetylene-sensitive C14-bicarbonate incorporation confirmed that bacterial nitrification occurred. During late January to early March (water temperature 2-3 degrees C), nitrification occurred at an average rate of about 13 micrograms N/liter/day for the years studied. Numbers of detectable nitrifying bacteria appeared to be too low (by 2 to 4 orders of magnitude) to account for the observed activity. The nitrification activity observed would result in average oxygen consumption amounting to 71% of the observed oxygen depletion. This shows that winter nitrification can be an important factor in promoting oxygen depletion and possibly winter-kill of fish. (Author's abstract)
W88-07080

MEASUREMENTS OF SPECIFIC RATES OF NET METHYL MERCURY PRODUCTION IN THE WATER COLUMN AND SURFACE SEDIMENTS OF ACIDIFIED AND CIRCUMNEUTRAL LAKES,
Manitoba Univ., Winnipeg. Dept. of Microbiology
L. Xun, N. E. R. Campbell, and J. W. M. Rudd.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 4, p 750-757, April 1987. 4 fig, 4 tab, 33 ref.

Descriptors: *Methylmercury, *Methylation, *Path of pollutants, *Acid rain, *Demethylation, *Chemical reactions, *Lakes, *Surface sediments, *Lake sediments, Acidic water, Ontario, Hydrogen ion concentration, Epilimnion, Sediments, Mercury, Fish, Acidification, Sediment-water interface.

Specific rates of mercury methylation and demethylation were determined for water and surficial sediment samples taken from several lakes located in the Experimental Lakes Area, northwestern Ontario. Specific rates of mercury methylation increased with decreasing pH in epilimnetic water samples in which pH was adjusted prior to incubation and in epilimnetic water samples taken from lakes of different pH. Reduction of pH also increased methyl mercury production at the sediment surface. Both increases and decreases in pH reduced specific rates of mercury demethylation. However, these changes were smaller than for methylation. Proportionally, specific rates of methylation increased faster than increasing concentrations of Hg(2+), while specific rates of mercury demethylation increased linearly with increasing concentrations of methyl mercury. Overall, it is predicted that the net rate of methyl mercury production in the water column and at the sediment-water surface will increase as a result of lake acidification, and this may at least partially explain why the mercury concentration of fish appears to increase during lake acidification. (Author's abstract)
W88-07081

CHLOROPHYLL-PHOSPHORUS RELATIONSHIPS FOR SUBARCTIC LAKES IN WESTERN CANADA,
M. L. Ostrofsky, and F. H. Rigler.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 4, p 775-787, April 1987. 8 fig, 3 tab, 19 ref.

Descriptors: *Chlorophyll a, *Phosphorus, *Lakes, *Subarctic lakes, *Primary productivity, *Mathematical models, Yukon Territory, Model studies, Northwest Territories, Canada, Mathematical equations, Seasonal variation, Prediction.

Concentrations of total phosphorus and chlorophyll a were measured weekly in 49 lakes in the vicinity of Yellowknife, N.W.T., Canada, from May to September 1977. The relationship between spring phosphorus concentration (TP-spr) and mean summer chlorophyll a concentration (Chl a-sum) was significantly different from the Dillon-Rigler model, but similar to relationships developed for lakes in Alberta, British Columbia, and the Yukon Territory. Empirical relationships were developed between TP-spr and maximum chlorophyll a concentrations and the probability of exceeding critical concentrations of chlorophyll a. These models may be potentially more useful than models which predict only a mean summer chlorophyll concentration. (Author's abstract)
W88-07082

VERTICAL TRANSPORT OF OXYGEN INTO THE HYPOLIMNION OF LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. J. Cornett, and F. H. Rigler.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 4, p 752-758, April 1987. 5 fig, 5 tab, 31 ref.

Descriptors: *Oxygen transport, *Lakes, *Hypolimnion, *Mathematical equations, *Limnology, Mathematical models, Heat budget, Vertical distribution, Oxygen, Diffusivity, Diffusion coefficient, Oxygen depletion, Model studies.

Rates of vertical transport of oxygen into the hypolimnion were calculated by multiplying the vertical eddy diffusivity coefficients, determined from the heat budget, by the measured gradients in oxygen concentration. In 12 lakes, transport ranged from 0 to 70 milligrams O2/sq m/day and was insensitive to the depth defining the upper boundary of the hypolimnion. Oxygen was transported into the hypolimnion of lakes with a thinner hypolimnion and out of the hypolimnion of lakes with a thick hypolimnion. Transport averaged 4% of the measured total rate of hypolimnetic oxygen depletion and <10% of the depletion rate in individual strata. Pooling these results with published estimates of oxygen gradients and eddy diffusivities suggests that in lakes with different status (phosphorus level 4-100 micrograms/liter) and size (areas from 0.4 to 70 sq km), vertical oxygen transport accounts for less than 15% of the hypolimnetic oxygen deficit. Oxygen depletion models will gain relatively little precision by including a vertical transport flux parameter. (Author's abstract)
W88-07083

PHOSPHORUS SPECIES IN THE SURFICIAL SEDIMENTS OF LAKES OF EASTERN NORTH AMERICA,
Biology Department, Allegheny College, Meadville, PA 16335, USA.
M. L. Ostrofsky.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 960-966, May 1987. 6 fig, 5 tab, 14 ref.

Descriptors: *Phosphorus, *Lake sediments, *Lakes, *Sediments, *Trophic level, *Alkalinity, Eastern North America, Surface sediments, Iron, Organic matter, Correlation analysis, Mathematical studies, Mathematical equations, Oligotrophy, Mesotrophy, Eutrophy.

Species of phosphorus, total iron, and organic matter were determined from surficial profundal sediments of 66 lakes of eastern North America. The lakes represented a broad range of lake type, from oligotrophic to eutrophic and from soft water to moderately alkaline. The sediment characteristics were less variable than the lake characteristics. Highly significant correlations were found between percent loss on ignition and sedimentary organic phosphorus and between sedimentary iron and NH4Cl-extractable, NaOH-extractable, HCl-extractable, total inorganic, and total phosphorus in the sediments. There was no relationship between spring total phosphorus or alkalinity and any sediment measured. The results suggest that lakes with high sedimentary iron have disproportionately higher concentrations of NH4Cl and NaOH-extractable phosphorus, two species that are most likely to contribute to internal loading of phosphorus. (Author's abstract)
W88-07084

EMPIRICAL MODELS FOR ZOOBENTHIC BIOMASS IN LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
J. B. Rasmussen, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 990-1001, May 1987. 3 fig, 5 tab, 132 ref.

Descriptors: *Biomass, *Benthic fauna, *Lakes, *Model studies, *Limnology, *Benthos, Regression analysis, Mathematical models, Mathematical equations, Estimating, Limnology, Littoral zone, Zones, Phytoplankton, Variability, Chlorophyll, Phosphorus, Transparency, Color, Morphometry, Temperature, Climate.

Estimates of macrozoobenthos from the literature were regressed against a series of limnological variables to yield empirical models for zoobenthic biomass in the profundal, sublittoral, and littoral zones of lakes. Variables indicative of phytoplankton biomass (chlorophyll concentration, total phosphorus concentration, and Secchi disk transparency) explained between 14 and 57% of the variance of zoobenthic biomass. Other factors such as humic color, morphometry (slope, mean depth, ratio of mean to maximum depth, and lake area), and mean annual air temperature substantially increased the amount of explained variance. In the profundal and sublittoral zones, the best models explain 70% of the variance in zoobenthic biomass. Littoral zone models explained less than 50%, and this deficiency was attributed to sampling difficulties and to high local variability of slope and wave exposure in the littoral zone. (Author's abstract)
W88-07085

EQUILIBRIUM MODELS FOR SEASONAL DYNAMICS OF PLANKTON BIOMASS IN FOUR OLIGOTROPHIC LAKES,
British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
C. J. Walters, E. Krause, W. E. Neill, and T. G. Northcote.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1002-1017, May 1987. 9 fig, 4 tab, 59 ref.

Descriptors: *Plankton, *Biomass, *Oligotrophic lakes, *Grazing, *Model studies, Seasonal varia-

tion, Equilibrium, Lakes, Dynamics, British Columbia, Zooplankton, Phytoplankton, Temperature effects, Canada, Metabolism.

Plankton biomass dynamics were monitored over an 11-year period in four coastal British Columbia lakes while they were disturbed by salmonid introductions, fertilization, and zooplankton harvesting. Except for dramatic zooplankton responses to fertilization, the lakes had relatively simple and stable seasonal biomass patterns, with midsummer zooplankton peaks and no clear seasonal cycles in biomass of unicellular phytoplankton. Simple models predict that equilibrium biomass should follow the observed pattern, provided zooplankton grazing and metabolic rates are temperature independent; experimental measurements of these rates did not show clear temperature dependence. Enclosure studies showed that phytoplankton biomass can return quickly (48-72 hours) to equilibrium after disturbance, but zooplankton biomass responds more slowly (2- to 3-week recovery times), yet fast enough to track a seasonally varying equilibrium. It is concluded that the biomass equilibrium of unicellular phytoplankton is set by grazing and metabolic rates of zooplankton, while the zooplankton biomass equilibrium is set by phytoplankton productivity. (Author's abstract)
W88-07086

REPRODUCTIVE RESPONSES OF FIVE WHITE SUCKER (CATOSTOMUS COMMERSONI) POPULATIONS IN RELATION TO LAKE ACIDITY,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-07087

SHORT-TERM EFFECTS OF ZOOPLANKTON MANIPULATIONS ON PHOSPHATE UPTAKE,
Waterloo Univ. (Ontario). Dept. of Biology.
D. T. Hamilton, and W. D. Taylor.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1038-1044, May 1987. 4 fig, 3 tab, 32 ref.

Descriptors: *Zooplankton, *Phosphorus uptake, *Lakes, *Phosphates, *Limnology, *Grazing, *Radioactive tracers, Epilimnion, Ontario, Phosphorus compounds, Algae, Bacteria, Protozoa, Predation, Organic carbon.

Samples of epilimnetic water were collected, manipulated to alter their zooplankton fauna, and incubated in situ for 24 hours. It was hypothesized that removal and concentration of zooplankton would decrease and increase phosphate turnover time, respectively, and that the presence of zooplankton would increase the accumulation of added (P32)O4 by algae (particles greater than 1.0 micrometer (um)) relative to bacteria (particles 0.2-1.0 um). Although the treatments produced significant changes in turnover time and size distribution, neither hypothesis was supported; removal of zooplankton did not decrease turnover time, and it reduced the dominance of 0.2- to 1.0-um particles in phosphorus uptake. However, concentrating microzooplankton frequently increased turnover time. Zooplankton removal caused a relative increase in ciliates, suggesting that these protozoa may be limited by their predators rather than by resource levels. The results suggest that microzooplankton were the most important grazers and that the nutrient environment of phytoplankton was not directly affected by mesozooplankton. Phosphate dynamics were probably determined by bacteria, the protozoan predators of bacteria, and the supply of dissolved organic carbon. (Author's abstract)
W88-07088

WINTER AND SPRING PH DEPRESSIONS IN NORTHERN WISCONSIN LAKES CAUSED BY INCREASES IN PCO2,
Wisconsin Univ.-Madison. Center for Limnology.
T. K. Kratz, R. B. Cook, C. J. Bowser, and P. L. Brezonik.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1082-1088, May 1987. 4 fig, 2 tab, 34 ref. NSF Grant DEB 8012313. Little Rock Lake Experimental Acidification Projects CR812216-01-0 and CR810981-01. USDOE Contract DE-AC05-840R21400.

Descriptors: *Hydrogen ion concentration, *Seasonal variation, *Lakes, *Acid rain effects, *Limnology, *Carbon dioxide, Wisconsin, Alkalinity, Acidic water, Organic acids, Ice, Snowpack, Snowmelt.

Seasonal variation in pH in six clearwater northern Wisconsin lakes (mean pH 5.9-7.8; mean total alkalinity 9-830 microequivalents/liter) encompasses an annual range of 1.0-1.5 units in each lake, with lowest values characteristically occurring during the late winter and early spring. In detailed investigations of one lake, strong acid inputs, shifts in pCO2, and changes in organic acids were evaluated as possible mechanisms for pH depression. The results indicate that seasonal pH depressions are caused largely by pCO2 increases under the ice. Despite an acidic snowpack the pH depression could not be attributed to acid meltwater because total alkalinity did not change in the lake. The results emphasize the importance of using measurements other than pH in investigating the causes of acid dynamics of natural waters. (Author's abstract)
W88-07090

OXYGEN CONDITIONS IN TWO PRAIRIE POTHOLE LAKES DURING WINTER ICE COVER,
D. J. Baird, T. E. Gates, and R. W. Davies.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1092-1095, May 1987. 3 fig, 2 tab, 1 ref.

Descriptors: *Limnology, *Oxygen depletion, *Seasonal variation, *Lakes, *Ice cover, Oxygen, Depletion, Ice, Alberta, Regression analysis, Model studies, Sediments, Organic matter, Correlation analysis, Spatial distribution, Canada, Prairie potholes.

Winter oxygen depletion rates (WODR) from two small southern Alberta prairie lakes were much higher than reported in 1979 for similar lakes in Manitoba. Depletion of oxygen was nonlinear, and the most appropriate regression model used a log transformation indicating that depletion was exponential. A correlation between WODR and sediment organic content was found both within and between the two lakes studied. Spatial variation in WODR indicates that whole-lake WODR based on single-point vertical profiles may be highly inaccurate. Oxygen concentrations in the water column stabilized at low (0.5-2.0 milligrams/liter) levels although an anoxic water layer may occur over the sediment. (Author's abstract)
W88-07092

EMPIRICAL HYPOTHESIS TO EXPLAIN THE RESTRICTED DISTRIBUTION OF HYALELLA AZTECA (AMPHIPODA) IN ANTHROPOGENICALLY ACIDIFIED LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W88-07094

ALUMINUM, IRON, ZINC, AND LEAD IN BOG WATERS OF NORTHEASTERN NORTH AMERICA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5B.
W88-07095

EXPERIMENTAL ENRICHMENT OF A COASTAL STREAM IN BRITISH COLUMBIA: EFFECTS OF ORGANIC AND INORGANIC ADDITIONS ON AUTOTROPHIC PERIPHYTON PRODUCTION,
Limnotek Research and Development Inc., 4035 West 14th Avenue, Vancouver, B.C. V6R 2X3.
C. J. Perrin, M. L. Bothwell, and P. A. Slaney.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 6, p 1247-1256, June 1987. 7 fig, 1 tab, 42 ref.

Descriptors: *Salmon, *Trophic level, *Nutrients, *Periphyton, *Fish food, *Coastal streams, Stream improvement, Canada, Accumulation, Enzymes, Keogh River, British Columbia, Fertilizers, Organic matter, Nitrogen, Phosphorus, Barley, Chlorophyll a, Diatoms.

Periphyton accumulation rates and alkaline phosphatase activity were examined in reaches of the Keogh River, British Columbia, following additions of grain and inorganic fertilizer as separate treatments during spring-summer 1981. Two different levels of N and P addition were used: one to attain ambient N and P concentrations of 200 and 15 micrograms/liter, respectively, and the other to attain 400 and 20 micrograms/liter, respectively. Grain (rolled barley) was added monthly at 280 grams/sq m. N and P additions increased chlorophyll a accrual rates by more than an order of magnitude. Diatoms dominated the periphyton community until midsummer. In July and most of August, the relative importance of chlorophytes increased and biomass levels declined markedly in spite of continued nutrient additions. Grain additions resulted in no detectable change in periphyton accrual, but alkaline phosphatase activity increased by 35% over control levels. These results suggest that additions of labile organic matter to nutrient-deficient coastal systems can increase autotrophic P deficiency. Based on responses of juvenile salmonids, additions of inorganic nutrients to increase autotrophic production can maximize trophic enhancement in nutrient-deficient streams. (Author's abstract)
W88-07097

CHANGES IN THE ABUNDANCE OF BLUE-GREEN ALGAE RELATED TO NUTRIENT LOADINGS IN THE NEARSHORE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W88-07099

SUBSTRATE SPECIFICITY OF HETEROTROPHIC BACTERIA IN THE WATER AND SEDIMENT OF A CARP CULTURE POND,
Department of Fisheries, College of Agriculture and Veterinary Medicine, Nihon University, Shimouma 3, Setagaya, Tokyo 154 (Japan).
H. Sugita, K. Oshima, T. Fushino, and Y. Deguchi.
Aquaculture AQCLAL, Vol. 64, No. 1, p 39-46, June 15 1987. 4 tab, 14 ref.

Descriptors: *Decomposing organic matter, *Vibrionaceae, *Chitinolytic bacteria, *Cellulolytic bacteria, *Heterotrophic bacteria, *Substrate specificity, *Fish culture ponds, Japan, Carp, Casein, Tributyrin, Starch, Hydrolysis.

A total of 489 strains of bacteria were isolated from the water and sediment of a carp culture pond, and their ability to decompose five types of organic matter was examined. Casein, tributyrin and starch were hydrolyzed by 26-65% of the isolated bacteria while chitin and cellulose were refractory and decomposed by only 1.2-8.8% of the isolates. The decomposers of casein, tributyrin and starch were present in the water and sediment throughout the year and Vibrionaceae were the major decomposers. Chitinolytic and cellulolytic bacteria were detected during defined periods. (Author's abstract)
W88-07115

ESTIMATING MICROBIAL PRODUCTION AND GROWTH RATES IN AQUACULTURE PONDS USING RATES OF RNA AND DNA SYNTHESIS,
Hawaii Univ., Honolulu. Dept. of Oceanography.
B. A. Costa-Pierce, and D. B. Craven.
Aquaculture AQCLAL, Vol. 66, No. 1, p 69-78, October 1 1987. 3 tab, 33 ref.

Descriptors: *Algal production, *Bacterial production, *Ribonucleic acid, *Deoxyribonucleil acid,

*Aquatic bacteria, *Aquaculture, Heterotrophic production, Hawaii, Ponds, Microbial production, Bacteria, Adenosine triphosphate, Chlorophyll a, Microbial growth.

Measurement of total microbial productivity in aquaculture ponds is currently constrained by lack of methodology. In this study, rates of RNA and DNA synthesis were used to quantify water-column total microbial (algal, bacterial) production. Rates of primary (algal) production were simultaneously measured to quantify autotrophic processes in a survey of aquaculture ponds with and without polyculture and receiving conventional feed or manure. Total microbial production based on DNA synthesis rates ranged from 218 to 6620 g C/l/hr while heterotrophic production ranged from 35 to 3518 g C/l/hr. Primary production based on 14C-bicarbonate uptake ranged from 4 to 336 g C/l/hr. Heterotrophic production was greater than 50% of total microbial production on seven of the eight dates surveyed. Rates of RNA and DNA synthesis and total microbial production were highly correlated ($P < 0.01$) with ATP biomass. Autotrophic production was not significantly correlated with chlorophyll-a or ATP biomass. Total microbial productivities measured in this study by use of DNA synthesis methods indicate much higher rates of total production are occurring than previously estimated by conventional methods. (Author's abstract)
W88-07118

RECYCLING OF THE AQUATIC WEED, WATER HYACINTH, AND ANIMAL WASTES IN THE REARING OF INDIAN MAJOR CARPS,
Central Institute of Freshwater Aquaculture (ICAR), Kausalagang, Via: Bhubaneswar 751002, Orissa (India).
For primary bibliographic entry see Field 5D.
W88-07119

ENVIRONMENTAL CHEMISTRY OF ZINC IN HIMALAYAN SEDIMENTS,
Division of Soil Science, Sher-e-Kashmir University of Agricultural, Science and Technology, Shalimar Srinagar-Kashmir, India.
R. A. Kango.
Environment International ENVIDV, Vol. 13, No. 4/5, p 363-367, 1987. 1 fig, 6 tab, 13 ref.

Descriptors: *Zinc, *Mountain lakes, *Lakes, *Limnology, *Chemical analysis, *Lake sediments, *Sediments, Himalaya mountains, Silt, Organic matter.

Sediment samples isolated from six Himalayan lakes were investigated for their zinc content. Average zinc concentration ranged from 121 microgram/gram to 299 microgram/gram. Maximum portion of zinc was present in silt portion of the bulk sedimentary material. Strong complexation of zinc with the organic components of sedimentary material was observed. (Author's abstract)
W88-07132

COMPARATIVE STUDY OF TIN PROFILES WITH OTHER METALS AND PHOSPHORUS PATTERNS IN LACUSTRINE SEDIMENTS: MOBILITY AND POLLUTION,
1 - Laboratoire de Chimie Analytique - Faculte des Sciences - Avenue de l'Universite, 64000 PAU - France.
For primary bibliographic entry see Field 5B.
W88-07135

MODELING NUTRIENT BEHAVIOR IN WETLANDS,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W88-07164

DISSOLVED IRON AND ORGANIC MATTER IN NORTHERN PEATLANDS,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W88-07174

CRASSULA HELMSII (T. KIRK) COCKAYNE: IS IT AN AGGRESSIVE ALIEN AQUATIC PLANT IN BRITAIN,
Freshwater Biological Association, Wareham (England). River Lab.
F. H. Dawson, and E. A. Warman.
Biological Conservation BIOCOK, Vol. 42, No. 4, p 247-272, 1987. 7 fig, 1 tab, 43 ref.

Descriptors: *Aquatic plants, *Aquatic weeds, *United Kingdom, Swamp stonecrop, Macrophytes, Plant growth, Aquatic weed control, Submerged plants, Ponds, Lakes, Rivers, Acidic water, Alkaline water, Sediments, Aquatic soils, Biomass, Iron, England.

The occurrence of this aquatic macrophyte has rapidly increased during the last decade reaching 100 sites mainly in England; these range from shallow acidic seasonal pools to small, more alkaline, nutrient-rich lakes. It is frequently dominant and can grow in an emergent form from 0.7 m above the water to a submerged form 1.3 m in length, to depths of 3 m. Plant biomass is generally high with little seasonal cessation of growth. The habit is frequently a dense sward growth which smothers out other flora; it is present in ten reserves and is causing concern. It is widely available from aquatic suppliers, it has an enormous potential to propagate from small fragments and has a high growth rate. It is associated with soft sediments and possibly iron-rich areas; this is confirmed by growth trials in static water tanks. In flowing water trials, growth was even faster in water velocities up to 0.32 m/sec, indicating its potential, although no river sites in Britain are yet known. Control by physical removal, often recommended, results in numerous propagules and should be combined with a secondary technique. The initial study suggests that this plant will remain a problem and caution is required to prevent its further spread. Studies of techniques for its control are needed. (Author's abstract)
W88-07177

NATURAL WETLANDS ON SHINGLE AT DUNGENESS, KENT, ENGLAND,
Botany Department, Royal Holloway and Bedford New College, Huntersdale, Callow Hill, Virginia Water, Surrey GU25 4LN, U. K.
B. W. Ferry, and S. J. P. Waters.
Biological Conservation BIOCOK, Vol. 43, No. 1, p 27-41, 1988. 9 fig, 3 tab, 13 ref.

Descriptors: *Groundwater recession, *Wetlands, *Coastal marshes, *England, *Water table decline, Vegetation, Marshes, Aerial photography, Water level fluctuations, Rainfall, Evaporation, Water use, Coastal aquifers, Excavation, Lake sediments, Marine sediments, Future planning.

The Open Pits are the two largest of a series of natural wetlands situated on the shingle at Dungeness. From the fairly sharp boundary between the marine sediments and the overlying freshwater ones, it appears that the transition to freshwater conditions, as the Open Pits 'progressed' inland, was quite rapid. Their current vegetational status is discussed in relation both to natural development over hundreds of years and to more recent changes in which man has played a part. To obtain floristic data, a subjective scale of assessment (dominant, abundant, frequent, occasional, rare) was applied in localized homogeneous communities, such as sallow carr, reedswamp, etc. Aerial photographs, dating from 1946 to 1985, were used to map changes in the main vegetation types. Data on Open Pit water levels, and on water table levels in the adjacent shingle (measured in tube wells), were made available by the Folkestone and District Water Company. Rainfall and evaporation data were obtained from the Meteorological Office. Evidence indicates that a decline in water levels in the early 1970s was caused by a combination of increased water abstraction from the shingle aquifer and major gravel excavations close to the Open Pits. Loss of valuable Carex-rich marsh, known to have been present in the 1950s, was due to the same decline in water levels. The future of the Open Pits is discussed, with emphasis on reasons for permitting further natural development. (Author's abstract)
W88-07178

AQUATIC MACROPHYTES OF LAKE MIZE, FLORIDA, 1968-1980,
Clayton State College, Morrow, GA 30260.
H. D. Brown.
Bulletin of the Torrey Botanical Club, Vol. 114, No. 2, p 180-182, 1987. 1 tab, 11 ref.

Descriptors: *Aquatic plants, *Macrophytes, *Lakes, *Eutrophication, *Florida, Rooted aquatic plants, Submerged plants, Lake restoration, Eutrophic lakes, Color, Oligotrophic lakes, Ducks, Nutrients, Dissolved solids, Revegetation.

Lake Mize is a brown-water lake containing large amounts of dissolved organic materials near Gainesville, Florida. In May, 1968, eight aquatic macrophytes were present in the lake, including the submerged Eleocharis baldwinii, Sphagnum macrophyllum, and Mayace aubleti as well as the emergent Pancium hemitomon and Leersia oryzoides. In the latter part of 1968, a flock of mallard ducks was placed on the lake by another investigator. Food given the ducks but not utilized resulted in accelerated eutrophication of the lake with accompanying changes in the aquatic flora. By May 1970, three of the aquatics had disappeared from the lake--two of the three submerged species and the L. oryzoides. Also, the population of P. hemitomon had increased greatly, appearing as a dense growth around the shoreline. The ducks were removed in 1972. A partial recovery of the lake then occurred, with most species disappeared during the eutrophic phase reappearing by the spring of 1980 and P. hemitomon declining. Eleven species of aquatics were present in 1980. (Author's abstract)
W88-07181

SNOWMELT RUNOFF PATHWAYS IN A BOREAL FOREST HILLSLOPE, THE ROLE OF PIPE THROUGHFLOW,
Laboratory of Forest Hydrology, Department of Forest Sciences, Bureau 0866, Pavillon Vachon, Laval University, Sainte-Foy, Que. G1K 1P4, Canada.
For primary bibliographic entry see Field 2G.
W88-07191

INACTIVATION OF SOME THIRD-GENERATION CEPHALOSPORINS BY BETA-LACTAMASES OF NON-FERMENTATIVE GRAM-NEGATIVE BACTERIA ISOLATED FROM FRESHWATER OF A REMOTE ENVIRONMENT,
Department de Microbiologia, Recursos Naturales, Universidad de Concepcion, Casilla 2407, Concepcion, Chile.
H. Bello, R. Norambuena, M. A. Mondaca, R. Montoya, and R. Zemelman.
Letters in Applied Microbiology, Vol. 5, No. 6, p 123-126, 1 tab, 9 ref.

Descriptors: *Cephalosporins, Beta-lactamases, Enzymes, Resistance, Susceptibility, Antibiotics, Genetics, Fresh water, Cefotaxime, Cefoperazone, Ceftazidime.

Inactivation of cefotaxime, cefoperazone and ceftazidime by beta-lactamases from strains of Pseudomonas sp. and Acinetobacter calcoaceticus isolated from freshwater of a remote environment is demonstrated. Inactivation rates showed some relationship to susceptibility of the strains as a whole, but this relationship was absent for individual strains, probably because of some other resistance mechanisms. Inactivation was also observed with low inocula if incubation was prolonged. These beta-lactamases seem to be coded by chromosomal genes, since no plasmids were found and they exhibited relatively high isoelectric points. (Author's abstract)
W88-07214

LAKE WATER COLOR: COMPARISON OF DIRECT OBSERVATIONS WITH UNDERWATER SPECTRAL IRRADIANCE,
Water Quality Centre, MWD, Private Bag, Hamilton, New Zealand.
For primary bibliographic entry see Field 7B.
W88-07272

DEEP WASTEWATER RESERVOIRS IN ISRAEL: I. LIMNOLOGICAL CHANGES FOLLOWING SELF-PURIFICATION,
Human Environmental Sciences Division, School of Applied Science and Technology, The Hebrew University of Jerusalem, Israel.
For primary bibliographic entry see Field 5D.
W88-07359

SIMULATED RESPONSE OF AN ACIDIC ADIRONDACK LAKE WATERSHED TO VARIOUS LIMING MITIGATION STRATEGIES,
Science and Policy Associates, Inc., Washington, DC.
For primary bibliographic entry see Field 5G.
W88-07442

COLORS OF GLACIER WATER,
E. Aas, and J. Bogen.
Water Resources Research WRERAO, Vol. 24, No. 4, p 561-565, April 1988. 5 fig, 2 tab, 13 ref.

Descriptors: *Glacier water, *Optical properties, *Suspended sediments, *Limnology, *Adsorption, *Lakes, Wavelength, Sand, Silt, Clay, Lake Veitastrondsvatn.

The optical characteristics of sediment suspensions in the glacier fed lake Veitastrondsvatn, Norway, were examined to explain observed color variations. The color depends on the wavelength where the ratio between the backward scattering coefficient and the absorption coefficient of the suspension has its maximum. This usually coincides with the wavelength where the absorption has its minimum. The absorption coefficient of the small particles of clay and silt size decreases with increasing wavelength, but the absorption coefficient of the suspension obtains a minimum in the green part of the spectrum, due to the strong absorption of red light by water. The suspension of such particles in the surface layer of the lake will then appear green. The coefficients of larger particles of sand size are almost independent of wavelength, with no significant maximum or minimum, and river waters close to the glacier fronts, which are dominated by these particles, will appear milky. (Author's abstract)
W88-07446

NUMERICAL MODELING OF SEPARATION EDDIES IN SHALLOW WATER,
Washington Univ., Seattle. Dept. of Civil Engineering.
H. H. Yeh, W. S. Chu, and O. Dahlberg.
Water Resources Research WRERAO, Vol. 24, No. 4, p 607-614, April 1988. 10 fig, 14 ref.

Descriptors: *Model studies, *Mathematical studies, *Water currents, *Estuaries, *Eddies, *Separation eddies, *Shallow water, Hydrodynamics, Prediction, Simulation, Fluid mechanics, Flow.

The differences in flows that were observed in a laboratory experiment were compared with those calculated by two different depth-averaged hydrodynamic simulation models. The model was developed to approximate two-dimensional hydrodynamics in a horizontal plane using a set of vertically averaged hydrodynamics equations. The model includes more horizontal momentum exchanges by introducing depth-averaged momentum diffusion terms. Significant discrepancy was found between laboratory observed separation eddies and those predicted by two numerical models. One major cause of discrepancy between observed and computed flow is due to the failure of the numerical grid to register the mathematically singular separation point and the steep gradient across the developing shear layer. The model only perceives that the mass of water in the lee of the barrier is immobile at the outset of the simulation. The inertia of the flow will transport the fluid undisturbed a distance downstream of the barrier. The spatial averaging process will then cause momentum to diffuse into the stagnant fluid, setting it in motion and thus creating the circulating flow. This numerically simulated diffusion of momentum occurs at a much higher rate than the actual dissipation of the free shear layer. The resulting recirculation zone is therefore severely truncated, forming only one clearly distinguishable eddy instead of the chaotic circulation observed in the experiment. In order to further reduce the strong numerical effects in the simplified models, the grid size must be substantially reduced. It is emphasized that the discussion is limited to flow controlled by steady separation eddies. For some natural estuaries and coastal waters, flow is unsteady and controlled by complex bathymetry and boundaries that partially enclose the water body. In those conditions where separation eddy may not be the dominant mechanism for the formation of gyres, the models could still characterize the main flow features quite accurately. For resolving flows which are clearly dominated by separation eddies, the models appear to be in question. (Alexander-PTT)
W88-07451

ZOOPLANKTON-MEDIATED TRANSITIONS BETWEEN N- AND P-LIMITED ALGAL GROWTH,
Notre Dame Univ., IN. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-07463

CONCURRENT GRAZING EFFECTS OF TWO STREAM INSECTS ON PERIPHYTON,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. R. Hill, and A. W. Knight.
Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 15-26, January 1988. 2 fig, 7 tab, 23 ref.
California Water Resources Grant UCAL-WRC-W-651.

Descriptors: *Limnology, *Population dynamics, *Biomass, *Food chains, *Larvae, *Algae, *Grazing, *Insects, Aquatic habitats, Aquatic animals, Streams, Caddisflies, Mayflies.

The grazing effects of caddisfly larvae (Neophylax) and mayfly nymphs (Ameletus) were measured in Barnwell Creek, a second-order stream in northern California. The densities of these grazers were manipulated in situ with flow-through Plexiglas channels that contained natural cobble substrate. After 13 d, log-transformed measures of periphyton standing crop (ash-free dry matter, chlorophyll a, and algal biovolume) were inversely proportional to Neophylax biomass. The negative effect of caddisfly larvae on algal biomass resulted primarily from depletion of Epithemia sp. 1, an undescribed diatom species that accounted for most of the algal biovolume in the periphyton. Neophylax guts contained disproportionately large numbers of Epithemia sp. 1. Ameletus had no significant effect on overall Chl a or algal biovolume but substantially decreased the biovolume densities of Nitzschia spp., Synedra spp., Amphipleura pellucida, and Melosira varians. Ameletus guts contained disproportionately large numbers of a small Nitzschia species. Neophylax growth in the channels was density-dependent, implicating intraspecific competition for food. Periphyton from the unmanipulated streambed resembled periphyton in experimental channels stocked with natural densities of grazers, allowing extrapolation of experimental results to the unmodified stream. (Author's abstract)
W88-07464

COMPARATIVE TRANSPARENCY, DEPTH OF MIXING, AND STABILITY OF STRATIFICATION IN LAKES OF CAMEROON, WEST AFRICA,
Duke Univ., Durham, NC. Dept. of Zoology.
G. W. Kling.
Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 27-40, January 1988. 10 fig, 4 tab, 53 ref. NSF Grants BSR 84-00532 and EAR 87-09978.

Descriptors: *Limnology, *Thermocline, *Thermal conductivity, *Lake morphometry, *Tropical regions, *Lakes, *Transparency, *Water temperature, *Oxygen, *Cameroon, Mixing depth, Morphometry, Lakes.

Morphometry, oxygen concentration, temperature, and transparency were studied in 39 natural lakes in Cameroon, West Africa. Thermal profiles from 31 of the lakes and data from published studies were used to calculate stability of thermal stratification and evaluate morphological correlates of mixing depth. Twenty-six lakes showed some degree of stratification and 17 had distinct thermoclines and well-developed, anoxic hypolimnia. Total stability of the water column ranged from 0 to 5,784 J/sq m. The high values were similar to or greater than those of other tropical and temperate lakes. Lake depth seems to exert a stronger influence on stability than does lake area, but depth or stability measures alone provide little information about heat distribution or mixing regime. A strong positive relationship between water transparency and thermocline depth in both tropical and temperate lakes suggests that reductions in buoyant resistance to vertical mixing, caused by deeper penetration of solar radiation, are important in establishing mixing depths in various lakes. Comparisons of persistent thermocline depth in tropical vs. temperate lakes, regardless of size, indicate that mixing depths in tropical lakes are often greater than those in their temperate counterparts. This difference is caused in part by the narrow ranges of temperature and smaller absolute density gradients in these tropical lakes, against which the mixed layer is deepened. (Author's abstract)
W88-07465

FACTORS CONTROLLING NUTRIENT CONCENTRATIONS IN AMAZON FLOODPLAIN LAKES,
Washington Univ., Seattle. Quaternary Research Center.
B. R. Forsberg, A. H. Devol, J. E. Richey, L. A. Martinelli, and H. dos Santos.
Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 41-56, January 1988. 10 fig, 2 tab, 42 ref.
NSF Grant BSR-8107522.

Descriptors: *Limnology, *Cycling nutrients, *Suspended sediments, *Lakes, *Floodplains, *Amazon River, *Phosphorus, *Nitrogen, Nutrients, Runoff, Chlorophyll a, Transparency, River basins, Catchment Areas, Water level.

Nutrient chemistry in lakes of the central floodplain of the Amazon River is influenced by the relative mix of waters of river and local origin. At high water the lakes contained primarily river water, lake and river total nitrogen (TN) levels were similar, concentrations of total suspended solids (TSS), soluble reactive phosphorus (SRP), dissolved inorganic nitrogen (DIN), and total phosphorus (TP) in the lakes were significantly lower than those in the river, and chlorophyll a (Chl a), transparency, and TN:TP levels were higher. The apparent decline in TP in the lakes was correlated with river TSS, suggesting a sedimentation loss. The higher TN:TP in the lakes reflected the differential loss of TP. At low water the percentage of local water in most lakes increased. The relative magnitude of this increase and its effect on nutrient chemistry depended on the ratio of drainage basin area to lake area (BA:LA). Lakes with BA:LA $<$ 20 contained a mixture of river and local water by the end of the low water period with a variable nutrient composition; lakes with BA:LA $>$ 20 contained primarily local water with a nutrient composition similar to that of forest runoff. Concentrations of TP in the lakes were near the levels expected from conservative mixing, suggesting a partial recovery of TP lost during high water. Levels of TN and TN:TP were higher than those expected from conservative mixing, suggesting an additional source of N. (Author's abstract)
W88-07466

PHYTOPLANKTON POPULATION DYNAMICS AND THE FATE OF PRODUCTION DURING THE SPRING BLOOM IN AUKE BAY, ALASKA,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W88-07467

CYANOPHYTE BLOOMS: THE ROLE OF CELL BUOYANCY,
Western Australia Univ., Nedlands. Centre for Water Research.
S. E. Humphries, and V. D. Lyne.
Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 79-91, January 1988. 7 fig, 1 tab, 67 ref.

Descriptors: *Limnology, *Model studies, *Population exposure, *Eutrophication, *Cyanophyta, *Cell Buoyancy, *Growth, Population dynamics, Biomass, Phytoplankton, Lakes.

A one-dimensional model of growth diffusion and scaling arguments showed that bloom formation in epilimnetic cyanophytes is attributable to the passive mechanism of positive buoyancy of the cells, which enhances the average exposure of the population to light. The effects of interacting turbulent diffusion, photic depth, mixed-layer depth, and diurnal mixed-layer excursions on population growth rate and biomass production differ radically for positively and negatively buoyant cells. Over the typical range of sinking and rising velocities for lake phytoplankton and the characteristic velocities of turbulent mixing, the proportion of the maximum achievable growth rate attained is always greater for a positively buoyant species until significant self-shading occurs. The magnitude of the difference is determined by the ratio of photic depth (Z sub p) to mixed-layer depth (Z sub m); the advantages of positive buoyancy decrease as Z sub p approaches Z sub m. Results suggest that a positively buoyant population is able to track diurnal mixed-layer excursions and thus to experience a more favorable average daily Z sub p:Z sub m ratio than is possible for a negatively buoyant population. (Author's abstract)
W88-07468

EFFECTS OF COMPETITIVE INTERACTIONS ON THE BIOMASS DEVELOPMENT OF PLANKTONIC AND PERIPHYTIC ALGAE IN LAKES,
Littoral Ecology Research Group, Dept. of Ecology, Limnology, P.O. Box 65, S-221 00 Lund, Sweden.
L. A. Hansson.
Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 121-128, January 1988. 6 fig, 1 tab, 28 ref.

Descriptors: *Limnology, *Population dynamics, *Biomass, *Isotope studies, *Radioactive tracers, *Cycling nutrients, *Algal growth, Phosphorus, Nutrients, Phytoplankton, Trophic level, Field tests, Lakes.

The influence of competitive interactions on biomass development of planktonic and periphytic algae was investigated in laboratory and field experiments. In the laboratory periphytic algae, covering the sediment surface, reduced the outflow of labeled phosphorus (33PO4(3-)) from sediment to water. The reduced outflow caused a decrease in phosphorus content as well as in biomass of planktonic algae. An enclosure field experiment showed that the biomass of periphyton decreased as the density of planktonic algae increased. These results suggest that periphytic algae have a competitive advantage with respect to nutrients released from sediments, whereas phytoplankton are competitively superior with respect to light. The imbalance in competitive ability between the two life-forms predicts a decrease in periphytic and an increase in planktonic algal biomass with increasing trophic state of lakes. This prediction was corroborated with a field study of Swedish lakes. The investigations suggest that competitive interactions influence the balance between planktonic and periphytic primary production in lakes. (Author's abstract)
W88-07469

SIMULATIONS OF THE WAVES IN LAKE BOTNEN CREATED BY THE RISSA LANDSLIDE,
University of Strathclyde, Glasgow (Scotland).
J. M. Townson, and Y. Kaya.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 85, No. 2, p 145-160, March 1988. 10 fig, 2 tab, 10 ref.

Descriptors: *Waves, *Floodwaves, *Model studies, *Fluid mechanics, *Lake Botnen, *Landslides, Comparison studies, Mathematical studies, Norway, Surges.

The well-known clay landslide at Rissa in Norway also caused flooding by generating surges in Lake Botnen. Physical and mathematical model investigations of these waves were conducted. A hydraulic scale model of Lake Botnen, having a novel slide-action mechanism, was built in the laboratory at the University of Strathclyde. The data obtained from this physical model were then used for numerical calculations at two levels of grid resolution. Comparisons were made between physical and numerical model results and with available field data. (Author's abstract)
W88-07478

WIND SET-UP ERROR IN MEAN LAKE LEVELS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 223-243, July 15, 1987. 3 fig, 8 tab, 14 ref.

Descriptors: *Lake level, *Networks, *Limnology, *Errors, *Lake Erie, *Lake breezes, *Wind tides, *Gaging, *Water level fluctuations, *Mathematical analysis, Thiessen weights, Sampling, Water level.

Lake surfaces tilt under steady wind set-up; downwind water-level gage readings increase while upwind gage readings decrease. This gives an error in the mean (spatial average) gage readings with consequent error in lake volume estimates that are based on the mean lake level. This error may be minimized or even eliminated by judicious selection of gage locations and weights for averaging. The wind set-up errors in computed mean lake levels are estimated from linearized hydrodynamic shallow-water equations applied to Lake Erie for historical and current gage networks. Observations of maximum unit error (that results from a unit wind stress) with each of the historical networks and with the current network are consistent with lake orientation and network placement considerations. Optimum network gage selections are made from the sixteen available Lake Erie gages to minimize the mean square set-up error estimated over one season's wind data, the mean square total error estimated from daily data for twelve years, and the mean square total error with constraints on the network size. It is not possible to eliminate wind set-up errors in mean lake levels with the constraint that Thiessen weights be used (although errors can be kept quite small). Without this constraint, however, wind set-up errors can be eliminated from mean lake level computations. This allows selection of weights that minimize other types of errors. (Author's abstract)
W88-07512

EVALUATION OF THE GREAT LAKES NEARSHORE INDEX,
Dept. of Environmental Health, College of Public Health, P.O. Box 26901, Oklahoma City, OK 73190.
L. J. Schierow, and G. Chesters.
Water Research WATRAG, Vol. 22, No. 3, p 269-277, March 1988. 7 tab, 44 ref.

Descriptors: *Lakes, *Water quality control, *Great Lakes, *Water pollution effects, *Data interpretation, Model studies, Great Lakes Nearshore Index, Aquatic habitats, Habitats.

The Great Lakes Nearshore Index is a model designed to evaluate overall quality of aquatic environments in 3-km segments of mixing zones along the shoreline of the North American Great Lakes. The structural characteristics and performance of this model have been tested to determine its validity and reliability in producing water quality ratings. Model components were examined in light of the goals of those who sponsored its development, the concerns of water quality managers and other residents in the Great Lakes Basin, and by reference to the literature of water quality management. The validity of each component as a partial measure of water quality was assessed by comparing the laboratory results of water sample analyses for each variable with the models's ratings for the same data sets. Validity of the U.S./Canada International Joint Commission and with classifications based on biological surveys. Reliability of ratings was calculated statistically and expressed in terms of confidence intervals and required sample size for data sets averaged annually. Results of the study generally support the validity and reliability of the model as a measure of average, annual quality for nearshore aquatic environments of the Great Lakes. However, recent publications and new legislation necessitate a revision in the toxic substance parameters. (Author's abstract)
W88-07537

NITRIFICATION IN ONTARIO STREAM SEDIMENTS,
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W88-07539

PHOSPHORUS RELEASE FROM THE PEATY SEDIMENTS OF THE LOOSDRECHT LAKES (THE NETHERLANDS),
Limnological Institute, Vijverhof Laboratory Rijksstraatweg 6, 3631 AC Nieuwersluis, The Netherlands.
For primary bibliographic entry see Field 5G.
W88-07548

FAILURE OF SPRING TURNOVER IN ONONDAGA LAKE, NY, U.S.A.,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W88-07591

IN SITU COMPARTMENTATION AND BIOMAGNIFICATION OF CHROMIUM AND MANGANESE IN INDUSTRIALLY POLLUTED HUSAINSAGAR LAKE, HYDERABAD, INDIA,
Dept. of Microbiology, Osmania Univ., Hyderabad, 500 007, India.
For primary bibliographic entry see Field 5B.
W88-07600

REGIONAL PATTERNS OF SULFUR RETENTION IN WATERSHEDS OF THE EASTERN U.S.,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2K.
W88-07609

EFFECTS OF SEDIMENT AND CONTAMINATED SEDIMENT ON STRUCTURAL AND FUNCTIONAL COMPONENTS OF EXPERIMENTAL STREAM ECOSYSTEMS,
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5C.
W88-07618

DEPRESSION OF PRIMARY PRODUCTION BY HUMIC MATTER AND SUSPENDED SEDIMENT IN LIMNOCORRAL EXPERIMENTS AT SOUTHERN INDIAN LAKE, NORTHERN MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
S. J. Guildford, F. P. Healey, and R. E. Hecky.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 8, p 1408-1417, August, 1987. 5 fig, 5 tab, 35 ref.

Descriptors: *Primary productivity, *Suspended sediments, *Field tests, *Humic acids, *Decomposing organic matter, *Manitoba, *Lakes, Ecology, Productivity, Sediments, Environment, Aquatic environment, Plankton, Phytoplankton, Aquatic plants, Soil types, Clays, Phosphorus, Biomass, Nitrogen, Iron, Heavy metals.

Eroding and flooded shoreline materials were added to a series of limnocorrals in Southern Indian Lake, northern Manitoba to simulate their effects on the phytoplankton following impoundment of the lake. Inorganic clays depressed primary productivity and phytoplankton biomass but relieved phosphorus deficiency. These effects appeared to be primarily due to reduction of light penetration; release of available phosphorus was small. Organic moss-peat material initially increased and then lowered primary productivity and biomass, while phosphorus deficiency was lowered. The initial stimulation could be traced to the release of soluble nitrogen and phosphorus. Enrichment experiments indicated that the depression was due to the binding of iron or some other metal by dissolved humic material. Responses of phytoplankton in the lake could be understood as a composite of responses seen in the limnocorrals to the two eroding shoreline materials. (Author's abstract)
W88-07638

LATENT EFFECTS OF PULSE EXPOSURE TO ALUMINUM AND LOW PH ON SIZE, IONIC COMPOSITION, AND FEEDING EFFICIENCY OF LAKE TROUT (SALVELINUS NAMAYCUSH) ALEVINS,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-07639

EMPIRICAL MODELS OF FISH RESPONSE TO LAKE ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W88-07640

EFFECTS OF SNOW AND ICE ON THE ANNUAL CYCLES OF HEAT AND LIGHT IN SAQVAQJUAC LAKES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
H. E. Welch, J. A. Legault, and M. A. Bergmann.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 8, p 1451-1461, August, 1987. 14 fig, 1 tab, 32 ref, 1 append.

Descriptors: *Snow cover, *Ice cover, *Annual distribution, *Saqvaqjuac lakes, *Arctic zone, *Heat, *Light penetration, Distribution, Climatic zones, Temperature, Stratification, Thermal stratification, Heat budget, *Lakes, Latent heat, Flow, Heat flow, Ice thickness, Lake ice, Nutrients.

The annual cycles of temperature, ice and snow cover, and light are described for small Saqvaqjuac lakes on the northwest coast of Hudson Bay. Summer thermal stratification occurred but was not persistent. Annual heat budgets were slightly higher than for temperate lakes and increased with increasing mean depth; latent heat of fusion constituted one half to one third of the total heat flow. Ice thickness reached a maximum of 1.6-2.2 m, depending upon winter snow cover, and a thin layer (5 cm) of white ice occurred in some years. Ice-out was a partial function of mean June temperature. The open-water season lasted 2-3 mo. Light attenuation through white and candled ice, snow, and water was measured. About 28% of the annual surface irradiance penetrated the unfrozen water, about half that which would have been absorbed under ice-free conditions. Extinction coefficients were inversely correlated with mean depth and positively correlated with nutrient status. (Author's abstract)
W88-07641

ROLE OF SPHAGNUM FIMBRIATUM IN SECONDARY SUCCESSION IN A ROAD SALT IMPACTED BOG,
Indiana Dunes National Lakeshore, Porter, IN.
For primary bibliographic entry see Field 5C.
W88-07643

SUSPENDED SPAWNING CANS FOR CHANNEL CATFISH IN A SURFACE-MINE LAKE,
Fisheries Research Laboratory, Southern Illinois University, Carbondale, Illinois 62901, USA.
For primary bibliographic entry see Field 8I.
W88-07662

RELATIONSHIPS OF PHYSICAL AND CHEMICAL CONDITIONS TO SPECIES DIVERSITY AND DENSITY OF GASTROPODS IN ENGLISH LAKES,
Department of Science, Crewe and Alsager College of Higher Education, Crewe, Cheshire CW1 1DU, England.
A. A. Savage, and G. M. Gazey.
Biological Conservation BIOCOK, Vol. 42, No. 2, p 95-113, 1987. 5 fig, 4 tab, 24 ref, append.

Descriptors: *Physical properties, *Chemical properties, *Population density, *Limnology, *Species diversity, *Gastropods, *Lakes, *Aquatic environment, Environment, Density, Species composition, Ecology, Organic matter, Regression analysis, Calcium, Magnesium, Sodium, Sulfates, Ions, Model studies, Conservation, Water conservation, England.

The qualitative and quantitative species composition of the communities of gastropods in 10 representative meres in the North West Midlands, England are described and shown to differ significantly. Environmental data were estimated on water chemistry, percentage organic matter in the substrata, mere area, and altitude. The data matrix was examined by regression analysis. Conductivity shows significant positive correlations with calcium, magnesium, sodium, and sulfate ions, while there is a significant negative correlation with altitude. The total individuals per mere of gastropods show the most significant positive correlation with calcium ions, while species per mere (species diversity) are similarly correlated with calcium + area + percentage organic matter. These results are compared with data from 58 North West Midlands meres and 43 Lake District tarns and lakes. The relationships demonstrated are used to develop a procedural and predictive model which facilitates the choice of water bodies for conservation. (Author's abstract)
W88-07669

ENVIRONMENTAL DEGRADATION IN THE PANTANAL ECOSYSTEM,
Laboratorio de Zoologica e Ecologia Animal, Departamento de Biologia Animal, Universidase de Brasilia, Brasilia, DF, 70910, Brazil.
For primary bibliographic entry see Field 4C.
W88-07671

ALGAE WITH A TASTE FOR THE UNUSUAL,
School of Science at the University of Buckingham, England.
A. Brook.
New Scientist NWSCAL, Vol. 115, No. 1577, p 55-57, September, 1987.

Descriptors: *Desmids, *Bogs, *Algae, *Plant physiology, Aquatic habitats, Chlorophyta, Lakes, Aquatic plants, Wetlands, Acidic water, Microscopy, Calcium, Barium, Heavy metals, Strontium.

The form and function of desmids, green algae of upland lakes, are reviewed. The greatest variety of desmids lives in the pools and hollows scattered throughout the blanket bog, and are also common at the edges and on the organic sediments at the bottom of lakes, lochs, and tarns. Some may be carried into open water to form part of free-floating plankton. Their single cells survive freezing and can live in the dark for three months or more, retaining their green color. The morphology of the cells is discussed, including the microstructure of the cytoplasm. Desmids exhibit some unusual chemical traits, as shown by analysis of the crystals found in some species. Results are presented of scanning electron microscope studies of the barium sulfate crystals of desmids. These crystals are mainly rectangular or rhomboidal, and can be three microns across. Preliminary work with microprobe analysis has also begun to cast light on the composition of the mucilage sheath around the cells; this contains potassium, iron, and sulfur, with traces of copper, zinc, strontium, and phosphorus. The importance of preserving the bog habitat is emphasized. (Doria-PTT)
W88-07675

CHESAPEAKE BAY DATA BASE: DOCUMENTATION OF HISTORICAL DATA IN THE LOWER SUSQUEHANNA RIVER BASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 7C.
W88-07736

MONITORING OF DOWNSTREAM SALMON AND STEELHEAD AT FEDERAL HYDROELECTRIC FACILITIES - 1986,
National Marine Fisheries Service, Portland, OR. Northwest Region.
R. C. Johnsen, L. A. Wood, and W. W. Smith.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009922. Price codes: A04 in paper copy, A01 in microfiche. Annual Report No. DOE/BP/20733--2, December 1986. 47 p, 2 fig, 1 tab, 6 ref, 3 append. DOE Contract No. DE-AI-79-85BP20733.

Descriptors: *Salmon, *Fish migration, *Dam effects, *Washington, Smolt, Migration, Lower Granite Dam, Lower Monumental Dam, Ecological effects, McNary Dam, John Day Dam, Bonneville Dam, Dams, Fish populations, Fish behavior.

The 1986 smolt monitoring project of the National Marine Fisheries Service provided data on the seaward migration of juvenile salmon and steelhead at Lower Granite, Lower Monumental, McNary, John Day, and Bonneville Dams. At Lower Monumental Dam, sampling provided data for an indication of smolt passage by species, and for comparison with the hydroacoustics passage index. To secure these data, it was necessary to monitor and index smolt passage at the three major sites. This involved: (1) the systematic sampling of the smolt migration from 5 April to 24 July at Lower Granite Dam, 26 March to 26 September at McNary Dam, and 28 March to 30 October at John Day Dam; (2) recovering and recording brands; and (3) daily reporting of all pertinent fish capture and river flow data for passage estimates and travel indices to the NMFS (National Marine Fisheries Service) Fish Passage Data Information System (FPDIS) for the Fish Passage Center. Recommendations from this study include: (1) Coordination of all activities affecting sampling/monitoring with those individuals or groups directly involved in the sampling process continues to be of major importance. Where multi-agency programs interact at one site, coordination is essential if each unit is to achieve its goals effectively; (2) The best achievable brand quality at time of release must remain as a high priority consideration; and (3) A more simplified means of identifying the discharge from PH (powerhouse) 1 and PH 2 at Bonneville Dam would be very helpful for future data reporting. (Lantz-PTT)
W88-07745

TEMPORAL VARIATION IN REGULATION OF PRODUCTION IN A PELAGIC FOOD WEB MODEL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. M. Bartell, A. L. Brenkert, R. V. O'Neill, and R. H. Gardner.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-008803. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-8703144--1, (1987). 40 p, 7 fig, 3 tab, 52 ref. EPA Contract No. DW899306009-01-0, NSF Grant No. BSR-8315185, and DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Temporal variation, *Food chains, *Phytoplankton, *Model studies, Temperature, Algae, Light intensity, Fish food, Zooplankton.

Current perspectives on processes that structure phytoplankton assemblages emphasize either preadaptation to specific conditions for optimal growth and associated competitive interactions or predator-prey interactions. Interest has rekindled in the ability of competition theory to explain patterns of species replacement in phytoplankton. Competition theory posits that differential rates of use of essential nutrients, relative to rates of their supply, confer advantages in growth rate to different algal species. Changes in algal community structure that result from competition alter the food course to consumer populations. Changes in the composition of higher trophic level may ultimately occur. From this perspective, the food web appears structured from the 'bottom-up' in relation to spatial and temporal variability in light intensity, temperature, and resource availability. Alternatively, regulation of community structure may be 'top-down'. Selective feeding by omnivorous fishes, planktivorous fishes, and zooplankton can cascade through lower trophic levels, ultimately determining the community structure of the phytoplankton. The implications of differential resource use and predator-prey relations in a seasonal environment, formalized as a pelagic food web model, on temporal changes in the relative importance of bottom-up and top-down structuring of the phytokplankton. Detailed analyses of the model's behavior were used to identify periods when control of production shifted from interspecific interactions among the phytoplankton to cascading trophic interactions. (Lantz-PTT)
W88-07746

MEASUREMENT OF RECOVERY IN LAKES FOLLOWING PHOSPHATE MINING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 4C.
W88-07758

NATIONAL SURFACE WATER SURVEY: WESTERN LAKE SURVEY-PHASE I, DATA BASE DICTIONARY,
Science Applications International Corp., Oak Ridge, TN.
P. Kanciruk, M. Gentry, R. McCord, L. Hook, and J. Eilers.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011956. Price codes: A05 in paper copy, A01 in microfiche. Report No. ORNL/TM-10307. Environmental Sciences Division Publication No. 2838, May 1987. 77 p, 16 tab, 20 ref. EPA Contract No. 40-1441-84.

Descriptors: *Lakes, *Lake classification, *Data storage and retrieval, *Hydrologic data, *Limnology, *Surveys, Chemical properties, Alkalinity, Acid rain, Databases, Computer programs.

The Western Lake Survey-Phase I (WLS-I), conducted in the fall of 1985, was the second part of a U.S. EPA field sampling effort known as the National Surface Water Survey. The WLS-I followed the Eastern Lake Survey-Phase I, which was conducted in the fall of 1984 and included the northeastern, southeastern, and upper midwestern regions of the United States. Both surveys were designed to quantify synoptically the lake chemistry in areas of the United States where the majority of lakes were expected to exhibit low alkalinity. These surveys were conducted as part of the National Acid Precipitation Assessment Program. The survey involved a three-month field effort in which 720 probability sample lakes and 32 special interest lakes in the western regions of the United States were sampled. This data dictionary describes the EPA's database. A description of the purpose, design, and results of the survey is contained in the two-volume report on the WLS-I. This dictionary does not report the results of the survey nor does it describe its purpose, design, or protocols. The purpose of the database dictionary is to provide data managers and programmers with the information necessary to transfer the WLS-I data accurately to their own computer systems. (Lantz-PTT)
W88-07760

NATURAL PROPAGATION AND HABITAT IMPROVEMENT, VOLUME II - IDAHO: ANNUAL AND FINAL REPORTS, 1985.
Bonneville Power Administration, Div. of Fish and Wildlife.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009928. Price codes: A14 in paper copy, A01 in microfiche. Report No. DOE/BP--725. 316 p.

Descriptors: *Idaho, *Lochsa River, *Eldorado Creek, *Upper Crooked Creek, *Clearwater River, *Camas Creek, Meyers Cove, *Anadromous fish, Fish conservation, Fish passages, Surveys, Fish populations, Costs, Fish establishment, Ecosystems, Fisheries.

In 1984, the Clearwater National Forest and Bonneville Power Administration entered into a contractual agreement to identify potential enhancement projects for anadromous fish in the Clearwater River Basin. The primary objectives of this project were to survey potential streams and identify opportunities to mitigate the effects of past and present influences. Selected tributaries of the Lochsa River were determined to be suitable for this type of project. This report presents a group of related studies concerning these tributaries and nearby systems, which include: (1) Lochsa River (Walde Creek, Lower Fish Creek, Deadman Creek, and Boulder Creek); (2) Eldorado Creek; (3) Upper Crooked Fork; (4) South Fork Clearwater River; and (5) Camas Creek. (See W88-07764 thru W88-07770) (Lantz-PPT)
W88-07763

WALDE, DEADMAN, LOWER FISH, AND BOULDER CREEKS ANADROMOUS FISH HABITAT SURVEY AND ENHANCEMENT PLAN,
Clearwater National Forest. Lochsa District.
D. E. Talbert, and F. A. Espinosa.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. p 1-24, 6 fig, 1 tab, 8 ref, append. DOE Contract No. DE-AI79-84BP16121.

Descriptors: *Walde Creek, *Lower Fish Creek, *Deadman Creek, *Boulder Creek, *Lochsa River, *Idaho, *Anadromous fish, Fish conservation, Surveys, Fish populations, Costs, Fish establishment, Ecosystems.

In 1984, the Clearwater National Forest and Bonneville Power Administration entered into a contractual agreement to identify potential enhancement projects for anadromous fish in the Clearwater River Basin. The primary objectives of this project were to survey potential streams and identify opportunities to mitigate the effects of past and present influences. Selected tributaries of the Lochsa River were determined to be suitable for this type of project. Four Lochsa River tributaries on the Lochsa Ranger District were identified as candidates for habitat mitigation. These streams were Walde, Deadman, Lower Fish, and Boulder Creeks. These streams were surveyed and analyzed to determine: (1) limiting factors to fish production; (2) the extent and severity of these limitations; and (3) the feasibility of eliminating and/or mitigating these factors. A plan was developed to display appropriate projects and costs associated with mitigating the impacts of identified limiting factors on fish. (See also W88-07763) (Author's abstract)
W88-07764

LOCHSA RIVER TRIBUTARIES ENHANCEMENT PROPOSAL,
Clearwater National Forest.
R. P. Kramer, G. C. Seloske, and F. A. Espinosa.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. Final Report FY 1985 through 1986. p 25-91, 7 fig, 13 tab, 9 ref, 4 append. DOE Contract No. DE-AI79-84BP16121, Project No. 84-31.

Descriptors: *Lochsa River, *Squaw Creek, *Doe Creek, *Papoose Creek, *Idaho, *Anadromous fish, *Fish conservation, Surveys, Fish populations, Costs, Fish establishment, Ecosystems.

In 1984, under the auspices of the Northwest Power Act, the Clearwater National Forest and Bonneville Power Administration entered into a contractual agreement to identify potential enhancement projects for anadromous fish in the Clearwater River Basin. The Lochsa River and its tributaries provide excellent opportunities for such a project. The primary objectives of this project were to survey potential streams and identify opportunities to mitigate the effects of past and present influences. Data was collected and analyzed to determine the source of local impacts, the extent and severity of the impacts, the feasibility of eliminating and/or mitigating these impacts, and identifying potential improvement areas geared towards improving the productive capability of the system. Three drainages were identified as possessing prime opportunities for mitigation practices. They are Squaw Creek; Doe Creek, a tributary of Squaw Creek; and Papoose Creek. A mitigation plan was developed which outlines proposed habitat enhancement structure types, their locations, and the cost of implementation of the proposal. (See also W88-07763) (Author's abstract)
W88-07765

ELDORADO CREEK: A PLAN FOR ENHANCEMENT OF KEY ANADROMOUS FISH HABITAT IN THE CLEARWATER RIVER BASIN,
Clearwater National Forest, Pierce Ranger District.
For primary bibliographic entry see Field 8I.
W88-07767

UPPER CROOKED FORK FISH BARRIER REMOVAL,
Clearwater National Forest.
For primary bibliographic entry see Field 8I.
W88-07768

SOUTH FORK CLEARWATER RIVER HABITAT ENHANCEMENT: ANNUAL REPORT - 1985,
Nezperce National Forest.
D. Hair, and R. Stowell.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. March 1986. p 260-282, 6 fig, 2 tab, append. DOE Contract No. DE-AI79-84BP16475, Project No. 84-5.

Descriptors: *Clearwater River, *Anadromous fish, *Fish passages, *Red River, *Idaho, Fisheries, Fish hatcheries, Salmon, Channels, Newsome Creek, Habitats.

In 1927 a dam was constructed on the South Fork of the Clearwater River at Harpster, which totally eliminated anadromous fish runs into this important spawning and rearing habitat. In 1935 a fish ladder was constructed at the dam but was reportedly only minimally successful. In 1962 the dam was completely removed. By this time, however, the anadromous runs had been eliminated from the drainage. Idaho Fish and Game began a program of reintroduction of anadromous salmonids in 1962. Hatching channels were constructed on Red River at the Red River Ranger Station and on Crooked River near Orogrande. These were stocked annually with eyed eggs. Species stocked varied and included coho salmon, chinook salmon and steelhead. The Crooked River channel was abandoned several years ago when the lease on private land terminated; however, the Red River Channel has continued in operation. Most of the recent use (1978-1983) has been with steelhead. In 1977 Idaho Fish and Game constructed a rearing pond at Red River which is used to rear 200,000 - 300,000 spring chinook salmon annually. The pond is stocked with fry in the spring. After rearing in the pond over the summer, a portion are marked and all are released into Red River at the pond site. The USFS began a program of active habitat improvement in the Red River, Crooked River, and Newsome Creek drainage systems in 1980. These efforts are continuing on an annual basis utilizing

Forest Service funding. Since the Bonneville Power Administration (BPA) project proposal has been approved, the Red River District has directed its emphasis to the South Fork of Red River, and the Elk City District has concentrated on Newsome Creek. These projects will complement the BPA work being carried out in Red River and Crooked River. The USFS contribution to the rehabilitation of the South Fork Clearwater system was $7,800 in 1983, $30,157 in 1984, $96,347 in 1985, and is projected to be $120,000 in 1986. (See also W88-07763) (Lantz-PTT)
W88-07769

CAMAS CREEK (MEYERS COVE) - ANADROMOUS SPECIES HABITAT IMPROVEMENT PLAN,
B. E. May, and R. W. Rose.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. p 283-316, 8 fig, 7 tab, 10 ref. DOE Contract No. DE-AI79-84BP16475, Project No. 84-23.

Descriptors: *Camas Creek, *Idaho, *Meyers Cove, *Management planning, *Fish management, Costs, Monitoring, Fisheries, Anadromous fish, Fish hatcheries, Salmon, Habitats, Spawning.

An analysis of potential enhancement and management options designed to improve instream and riparian zone conditions in the Meyers Cove area of Camas Creek, is given. The efforts expended will contribute to improvement of anadromous species spawning, incubation and rearing habitat. Potential production increases would provide some compensation for hydropower effects in other areas of the Columbia River basin. The overall project has been divided into two separate but interrelated phases. This first phase is designed to provide an assessment of enhancement options, potential schedules, and costs associated with the enhancement options. The second phase will involve implementation of actual enhancement measure and associated monitoring to verify fish response. The combined phases are intended to meet the stated project goal, which is to improve riparian and instream conditions of Camas Creek in the Meyers Cove area to increase spring chinook and steelhead trout spawning and rearing production potential. To assist in achieving this goal, this feasibility and design phase was funded, in part, by the Bonneville Power Administration (BPA). The project is a cooperative effort involving the U.S. Forest Service, Idaho Department of Fish and Game (IDFG), and the BPA. (See also W88-07763) (Lantz-PTT)
W88-07770

COLOR INFRARED VIDEO MAPPING OF UPLAND AND WETLAND COMMUNITIES,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7B.
W88-07782

AGRICULTURAL MANAGEMENT PRACTICES AND THE INTEGRITY OF INSTREAM BIOLOGICAL HABITAT,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 5G.
W88-07836

SOLID/SOLUTION INTERACTION: THE EFFECT OF CARBONATE ALKALINITY ON ADSORBED THORIUM,
Washington Univ., Seattle. School of Oceanography.
B. D. LaFlamme, and J. W. Murray.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 2, p 243-250, February 1987. 6 fig, 2 tab, 27 ref.

Descriptors: *Lakes, *Saline Lakes, *Limnology, *Thorium, *Alkalinity, *Alkaline water, *Goethite, *Solubility, Seawater, Comparison studies, Ionic strength, Adsorption, Hydrogen ion concentration, Chemical properties, Washington, Carbonate.

Elevated activities of dissolved Th have been found in Soap Lake, an alkaline lake in Eastern Washington. Dissolved super 232 Th ranges from less than 0.001 to 4.9 dpm/l compared with about 0.000013 dpm/l in sea water. The enhanced activity in the lake coincides with an increase in carbonate alkalinity. Experiments were conducted to evaluate the effect of pH, ionic strength and carbonate alkalinity on Th adsorption on goethite. Thorium (10 to the minus 13th power M total) in the presence of 5.22 mg/l alpha-FeOOH and 0.1 M NaNo3 has an adsorption edge from pH 2-5. At pH 9.0 plus or minus 0.6 the percent Th absorbed on the solid began to decrease from 100% at 100 meq/l carbonate alkalinity and exhibited no adsorption above 300 meq/l. The experimental data modeled to obtain the intrinsic adsorption equilibrium constants for Th hydrolysis species. These adsorption constants were incorporated in the model to interpret the observed effect of carbonate alkalinity on Th adsorption. There are two main effects of the alkalinity. To a significant degree the decrease in Th adsorption is due to competition of HCO3(-) and CO3(2-) ions for surface sites. Dissolved Th carbonate complexes also contribute to the increase of Th in solution. (Author's abstract)
W88-07923

DIAGENETIC CHANGES OF LIGNIN COMPOUNDS IN A MORE THAN 0.6 MILLION-YEAR-OLD LACUSTRINE SEDIMENT (LAKE BIWA, JAPAN),
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
R. Ishiwatari, and M. Uzaki.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 2, p 321-328, February 1987. 4 fig, 3 tab, 20 ref.

Descriptors: *Diagenesis, *Lakes, *Oligotrophic lakes, *Lake Sediments, *History, *Geologic time, *Lignin, *Organic compounds, Lake Biwa, Japan.

A vertical profile of lignin in the upper 700 m layer of a 1400 m sediment core of Lake Biwa, an oligotrophic freshwater lake in Japan, was determined using a CuO oxidative degradation method. The results indicated that lignin is found throughout the core, demonstrating lignin to be very stable for over 0.6 million years. Moreover, the upper 250 m (approx. 0.6 million years old) segment of the sediment core was investigated to determine the apparent long-term degradation rate of lignin. A downward lignin concentration decrease is observed over the upper 250 m of the core which corresponds to a calculated half-life of at least approx. 400,000 years assuming that the lignin decrease is due to its in situ degradation (diagenesis). (Author's abstract)
W88-07925

BIOGEOCHEMICAL MASS BALANCE OF PO210 AND PB210 IN AN OLIGOTROPHIC LAKE WITH SEASONALLY ANOXIC HYPOLIMNION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
G. Benoit, and H. F. Hemond.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 6, p 1445-1456, June 1987. 4 fig, 5 tab, 29 ref.

Descriptors: *Oligotrophic lakes, *Anoxia, *Hypolimnion, *Lead radioisotopes, *Polonium radioisotopes, *Radioisotopes, *Geochemistry, *Radiochemical analysis, *Lakes, *Ponds, *Sedimentation, *Seasonal variation, Scavenging, Surface runoff, Lead, Polonium, Radon, Chemistry of precipitation, Massachusetts, Aquifers.

The mass balances of Po210 and Pb210 were determined for Bickford Pond, Massachusetts. Activities of these nuclides at various depths within the water column, in sediments, in streams flowing into and out of the lake, and in precipitation were measured at approximately monthly intervals for a period of 1 year. Streamwater contained about 10 dpm/100kg of Pb210, mostly filtrable, and showed little variation with changing flow. Pb210 in the stream is believed to be mostly derived from Rn222 that enters groundwater via alpha-recoil from aquifer matrix materials. It is therefore not meteoric in origin and represents a local source to the lake. Surface inflow was equally important as precipitation as a source of Pb210 to the lake. Only half of total Pb210 input was trapped in sediments; the rest was lost from the lake as outflow. The Pb210 removal times via scavenging and sedimentation both averaged close 40 days, and Pb210 scavenging was almost an order of magnitude greater than that of Po210. (Author's abstract)
W88-07929

MOLECULAR WEIGHT OF AQUATIC FULVIC ACIDS BY VAPOR PRESSURE OSMOMETRY,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W88-07932

SEASONAL AND ANNUAL VARIATIONS IN THE ORGANIC MATTER CONTRIBUTED BY THE ST. LAWRENCE RIVER TO THE GULF OF ST. LAWRENCE,
Department of Fisheries and Oceans, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, N.S., Canada B2Y 4A2.
For primary bibliographic entry see Field 2E.
W88-07934

THERMAL REGIME OF PEATLANDS IN SUBARCTIC EASTERN CANADA,
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
Canadian Journal of Earth Sciences CJESAP, Vol. 24, No. 7, p 1352-1359, July 1987. 4 fig, 2 tab, 33 ref.

Descriptors: *Subarctic zone, *Frozen ground, *Peat bogs, *Seasonal variation, *Temperature effects, *Climates, Canada, Temperature, Snow pack, Peatlands, Thermal regime, Quebec, Thermal properties.

Temperatures were measured to 2 m depth at 6 peatland sites in the Schefferville area, northern Quebec, from July 1982 to September 1984. The sites varied in their plant cover, type of peat, and depth of snow, and 2 sites represented string and flark morphology. During the summers, the surface layers (5-10 cm) reached temperatures of 15-20 C and the 10 C isotherm reached depths of 50-150 cm, depending on the site characteristics and the influence of the preceding winter conditions. The progression of the 10 C isotherm downwards could be predicted from climatic variables, such as cumulative thawing degree-days. During the winter, the 0 C isotherm reached depths of between 20 and 90 cm, based primarily on the thickness of the insulating snowpack and its development during the winter. The surface layers (5-20 cm) of the peat remain close to freezing (-1 to -3 C), despite the very cold air temperatures (-20 to -30 C). Examination of a cooling and a warming sequence at the string and flark sites reveals that the string near the surface is about 2 C colder than the flark during the winter, and that during the early summer it can be 8-14 C warmer than the flark. Differences in thermal regimes between sites and between seasons are interpreted in terms of the major climatic factors and the characteristics of the sites. (Author's abstract)
W88-07936

SEDIMENTS OF ICE-DAMMED, SELF-DRAINING APE LAKE, BRITISH COLUMBIA,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
R. Gilbert, and J. R. Desloges.
Canadian Journal of Earth Sciences CJESAP, Vol. 24, No. 9, p. 1735-1747, September, 1987. 17 fig, 1 tab, 30 ref.

Descriptors: *Lakes, *Lake ice, *Iced lakes, *Glacial lakes, *Glaciers, *Sedimentation, *Varves, *Icebergs, *Lake sediments, Drainage, Subaerial erosion, British Columbia, Ice damming, Self-

draining lake, Limnology, Particle size, Seasonal variation, Organic matter.

The glacier damming Ape Lake has withdrawn from its Neoglacial terminal moraines in the lake since early in this century at an average rate of 15 m/yr. As a result, the first known drainings of Ape Lake occurred in October 1984 and August 1986. In each event, about 54% of the volume of the lake was lost through tunnel in the damming glacier. Most of the remaining water was held in the deep basin of the lake behind partially breached Neoglacial terminal moraines. As the glaciers have withdrawn, the character of the sediments has changed. Sediments in the deep basin of the lake are varved, but the grain size, especially of the summer deposits, has decreased and rates of sedimentation have decreased from about 4 mm/yr to less than 2 mm/yr. In shallow water, deposition of varved sediments has given way to the deposition of massive sediments at rates of less than 1 mm/yr. Ice-rafted debris is rare in deep water, despite the presence of calving bergs. During and following the first draining, significant subaerial erosion occurred as a result of the event itself, the drawdown and steepened gradients, and the action of waves on the exposed sediments as the lake refilled. In proximal areas, distinct deposits within the normal winter deposits are recognized. In deep water, deposition of massive, highly underconsolidated, fine-grained sediments occurred. Organic debris released from shallow deposits by erosion has become concentrated in both shallow- and deep-water sediments. Within a year of the first draining, sediment loads in the lake water were returning to normal. (Author's abstract)
W88-07937

SEDIMENTATION IN ICE-DAMMED HAZARD LAKE, YUKON,
Alberta Univ., Edmonton.
For primary bibliographic entry see Field 2J.
W88-07939

ECOSYSTEM SCIENCE FOR THE GREAT LAKES: PERSPECTIVES ON DEGRADATIVE AND REHABILITATIVE TRANSFORMATIONS,
Department of Zoology, University of Toronto, Toronto, Ontario M5S 1A1, Canada.
For primary bibliographic entry see Field 5G.
W88-07945

ECOLOGICAL RELATIONSHIPS OF WILD RICE, ZIZANIA AQUATICA: 7. SEDIMENT NUTRIENT DEPLETION FOLLOWING INTRODUCTION OF WILD RICE TO A SHALLOW BOREAL LAKE,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 4C.
W88-07946

NITROGEN CYCLING IN A FORESTED MINNESOTA BOG,
Environmental Engineering Program, Civil and Mineral Engineering Department, University of Minnesota, Minneapolis, MN 55455, USA.
N. R. Urban, and S. J. Eisenreich.
Canadian Journal of Botany CJBOAW, Vol. 66, No. 3, p 435-449, March 1988. 6 fig, 9 tab, 97 ref.

Descriptors: *Peat bog, *Nitrogen cycle, *Forests, *Nitrogen fixation, *Heterotrophic bacteria, *Mineralization, Minnesota, Sphagnum, Geochemistry, Microorganisms, Hydrogen ion concentration, Forrest watersheds.

The nitrogen cycle of a small, forested Sphagnum peatland in northern Minnesota was studied for 4 years. Hydrologic inputs and outputs (atmospheric deposition, upland runoff, steamflow) were monitored for 4 years, and annual uptake of N by vegetation was measured over a 3-year period. Microbe-mediated processes of nitrogen fixation and mineralization were measured in the laboratory and field, and accumulation rates of N within the peatland were measured in dated peat cores. Aerobic heterotrophs appear to be the dominant agents of N fixation at this site. Rates of N fixation decrease rapidly below the surface. Perhaps limited by moisture and low pH, N fixation (0.5-0.7 kg/ha/yr) is a minor input to the bog relative to the input from atmospheric deposition (10.4 kg/ha/yr). The bog is a large sink for N with approximately 65% of inputs retained. Annual turnover of N (66 kg/ha) is much larger than the total input (14.6 kg/ha). This large turnover is achieved by rapidly cycling a relatively small pool of N in the aerobic layers of peat. Plant uptake is closely coupled to mineralization such that losses from the system in runoff are small. However, 7 to 12 kg N/kg/yr is buried in aerobic peat and rendered unavailable to the biota. (Author's abstract)
W88-07947

EFFECTS OF A WATER-DEPTH GRADIENT ON THE GERMINATION OF LAKESHORE PLANTS,
Ottawa Univ. (Ontario). Dept. of Biology.
D. R. J. Moore, and P. A. Keddy.
Canadian Journal of Botany CJBOAW, Vol. 66, No. 3, p 548-552, March 1988. 2 fig, 2 tab, 44 ref.

Descriptors: *Limnology, *Germination, *Plant growth, *Lake shores, *Wetlands, *Revegetation, Water depth, Organic soils, Seed banks, Sand, Plant physiology.

The germination requirements of many wetland species commonly found in the seed bank are poorly understood. This study explored the germination responses of lakeshore plant species to a water-depth gradient on each of two soil types normally found on shorelines and to test whether germination patterns predict field distributions of adults. Germination patterns were determined in a greenhouse by sowing seeds of 24 lakeshore species along an artificial water-depth gradient, using two soil types (sand and organic soil). Those species showing significant treatment effects were then tested for similar or different germination patterns, using Kendall's coefficient of concordance. Species had similar germination patterns ($n=5$, $P=0.02$) on sand. Species had different germination patterns ($n=7$, $P>0.50$) on the organic soil. Mean water-depth of germination was significantly correlated with the mean depth occupied by adults in the field for seven species ($r=0.81$, $P=0.04$). Germination requirements are important in controlling recruitment of wetland species after disturbance. (Author's abstract)
W88-07948

OPTICAL ABSORBANCE OF DISSOLVED ORGANIC MATTER IN NATURAL WATER STUDIES USING THE THERMAL LENS EFFECT,
Chemistry Dept., Concordia University, 1455 West de Maisonneuve Boulevard, Montreal, Quebec, Canada H3G 1M8.
For primary bibliographic entry see Field 2K.
W88-07949

PACIFIC NORTHWEST RIVERS STUDY. 1986 FINAL REPORT: IDAHO,
Idaho Dept. of Fish and Game, Boise.
For primary bibliographic entry see Field 2E.
W88-07963

STREAM HABITAT ENHANCEMENT EVALUATION WORKSHOP: A SYNTHESIS OF VIEWS,
J. W. Buell.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009903. Price codes: A04 in paper copy, A01 in microfiche. Report No. DOE/BP/61982--T1, September 1986. Level I Workshop, March 1986, Hood River, Oregon. 256 p, 10 ref, 2 append. DOE Contract No. DE-AP79-86BP61982. Project No. 86-107.

Descriptors: *Streams, *Workshops, *Habitat enhancement, Environmental policy, Fish, Environmental impact statement, Habitats, Salmon.

Participants in the Level I Workshop, March 1986, Hood River, Oregon discussed a series of framework questions pertaining to the fundamental objectives of evaluating stream habitat enhancement, the elements of a good evaluation program, and the application of evaluation results. These discussions and written answers submitted by absentee contributors were synthesized to provide the Points of Agreement and Consenses presented in this document. Participants identified the following areas of particular concern: Limiting Factors, Acceptable Risk, Hierarchical Stratified Classification System, and the Effects of Underseeding. A separate section is devoted to these issues. Many significant points of agreement surfaced in the course of discussions. Many informational and procedural needs also were identified and became recurrent themes of the Level I Workshop. These informational and procedural needs are: (1) It is not safe, in any case, to assume that the creation or restoration of habitat will result in fish production; (2) More research is needed on the habitat requirements of all salmonid life stages; (3) The goals and objectives of any evaluation program or project must be clearly stated; (4) Assumptions are part of the real world and must be clearly stated; (5) Extrapolation of evaluation results must be done with care and between 'similar' streams; (6) A stream classification system is needed as the basis for extrapolation of evaluation results; (7) Management/decision makers need to decide the acceptable risk of implementing an enhancement measure based on the best data the evaluators can supply; and (8) Limiting factors must be identified, preferably some objective hierarchical analysis. (Lantz-PTT)
W88-07968

2I. Water In Plants

CHANGES OF WATER TEMPERATURE, PH, DISSOLVED OXYGEN, INORGANIC NITROGEN, AND PHOSPHORUS CONCENTRATIONS IN FLOWING IRRIGATION WATER ON PADDY SURFACE,
First Laboratory of Soil and Fertilizer, Environment Div., Chugoku Nat. Agricultural Experiment Station, Fukuyama, Hiroshima, 721 Japan.
For primary bibliographic entry see Field 5B.
W88-06827

STUDIES ON IMPROVEMENT OF NUTRIENT AND WATER SUPPLY IN CROP CULTIVATION ON SAND DUNE SOIL: 2. EFFECT OF FERTILIZER PLACEMENT AND IRRIGATION METHOD ON GROWTH AND NUTRIENT UPTAKE OF TOMATOES,
Faculty of Agriculture, Tottori Univ., Koyama, Tottori, 680 Japan.
For primary bibliographic entry see Field 3F.
W88-06828

EFFECT OF SALINITY ON LEAF IONIC CONTENT AND PHOTOSYNTHESIS OF TAXODIUM DISTICHUM L.,
Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.
For primary bibliographic entry see Field 2H.
W88-06838

OXYGEN PRODUCTION AND CONSUMPTION ASSOCIATED WITH THE MAJOR AUTOTROPHIC COMPONENTS IN TWO TEMPERATE SEAGRASS COMMUNITIES,
College of William and Mary, School of Marine Science, Gloucester Point, Virginia 23062.
For primary bibliographic entry see Field 2L.
W88-06856

PHYTOPLANKTON BIOMASS AND NUTRIENT DYNAMICS IN A TIDALLY INDUCED UPWELLING: THE ROLE OF THE NO3:SIO4 RATIO,
Maurice-Lamontagne Institute, Department of Fisheries and Oceans, PO Box 1000, 850 route de la Mer, Mont-Joli, Quebec G5H 3Z4, Canada.
For primary bibliographic entry see Field 2L.
W88-06858

BIOACCUMULATION AND METABOLISM OF TRI- AND DIALKYLLEAD COMPOUNDS BY A FRESHWATER ALGA,
Department of Fisheries and Oceans, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Canada Centre for Inland Waters, Burlington, Ont. L7R 4A6.
For primary bibliographic entry see Field 5B.
W88-07098

EFFECTS OF PLANT MOISTURE STRESS ON RED PINE (PINUS RESINOSA) SEEDLING GROWTH AND ESTABLISHMENT,
Woodlands Department, Mead Paper Corporation, Escanaba, MI 49829.
C. A. Becker, G. D. Mroz, and L. G. Fuller.
Canadian Journal of Forest Research CJFRAR, Vol. 17, No. 8, p 813-820, August 1987. 11 tab, 26 ref. U.S. Naval Electronics Systems Command Contract N00030-84-C0070.

Descriptors: *Drought resistance, *Plant growth, *Moisture stress, *Pine trees, Seedlings, Roots, Root development, Drying, Red pine, Drought, Plant water potential, Dry matter, Reforestation, Conifers.

Red pine 2-0 (root pruned to a length of 20 cm at the nursery) and 3-0 bare-root and 1-0 containerized seedlings were subjected to five different watering regimes (drying cycles). To avoid destruction of the samples, needle rather than xylem water potential was measured with a pressure bomb. Overall, moisture stress was highly correlated with seedling growth and survival. While shoot elongation during the drought period was unaffected, stressed seedlings showed pronounced decreases in cambial activity, secondary needle elongation, subsequent bud formation, root length, and number of active mycorrhizal root tips per centimeter compared with control treatments. This resulted in reduced top and root dry-matter production. Watering treatments with average seasonal internal moisture stress values in the range of -8 to -11 bar (1 bar = 100 kPa) showed no measurable reductions in seedling growth. Consistently, less internal moisture stress in the containerized seedlings indicate they are better able to avoid drought. Overall, performance of the 2-0 bare-root seedlings was superior to that of the 3-0 and containerized stock. (Author's abstract)
W88-07165

INFLUENCE OF FLOODING AND SOIL TEMPERATURE ON THE WATER RELATIONS AND MORPHOLOGICAL DEVELOPMENT OF COLD-STORED BLACK SPRUCE AND WHITE SPRUCE SEEDLINGS,
Toronto Univ. (Ontario).
S. C. Grossnickle.
Canadian Journal of Forest Research CJFRAR, Vol. 17, No. 8, p 821-828, August 1987. 5 fig, 1 tab, 37 ref.

Descriptors: *Plant morphology, *Flooding, *Soil temperature, *Plant growth, *Spruce trees, Black spruce, White spruce, Seedlings, Conductance, Plant water potential, Soil-water-plant relationships, Root development.

Fall-lifted, cold-stored black spruce (Picea mariana) and white spruce (Picea glauca) seedlings were planted in a controlled environmental chamber with an air temperature of 20 degrees C, soil temperatures of 10 or 20 degrees C, and flooded or nonflooded soil treatments. Stomatal conductance was lower in flooded seedlings compared with nonflooded seedlings for both black spruce and white spruce; black spruce seedlings drained after 14 days of flooding showed stomatal conductance similar to nonflooded seedlings, while drained white spruce seedlings had stomatal conductance patterns greater than nonflooded seedlings. White spruce seedlings had diurnal xylem pressure potential patterns slightly more negative in the flooded treatment compared with the nonflooded treatment; measured predawn xylem pressure potential was found to be more negative in flooded seedlings compared with nonflooded seedlings in both black and white spruce. In both species, flooded seedlings 1 day out of cold storage had a greater resistance to water flow through the soil-plant-atmosphere continuum (RSPAC) compared with non-flooded seedlings. After 21 days out of cold storage, RSPAC decreased in nonflooded seedlings of both species, while flooded seedlings of both species had high RSPAC values. For both black and white spruce seedlings, flooded soils inhibited root growth, while low soil temperatures resulted in a reduction in root growth in nonflooded seedlings. Shoot growth of white spruce seedlings was not influenced by 21 days of flooding or low soil temperature, while the combination of 21 days of flooding and low soil temperature in black spruce seedlings resulted in less shoot development compared with nonflooded seedlings. (Author's abstract)
W88-07166

EFFECTS OF SALINITY AND WATERLOGGING ON THE VEGETATION OF LAKE TOOLIBIN, WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 4C.
W88-07168

WATER UPTAKE BY PLANT ROOTS--A SIMULATION MODEL: I. CONCEPTUAL MODEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
P. Perrochet.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 55-61, 15 November 1987. 4 fig, 13 ref.

Descriptors: *Absorption, *Plant tissues, *Roots, *Simulation analysis, *Mathematical models, Soil-water-plant relationships, Irrigation, Volumetric analysis, Continuity equation, Transpiration, Climates, Agriculture, Plant water potential, Root distribution, Soil water suction, Irrigation practices, Aeration zone, Natural recharge, Artificial recharge, Water table.

Considering on one hand how complex the relations between the soil, the plant and the atmosphere are in natural conditions, and on the other hand the many experimental studies of particular cases already carried out by research workers, it is justified and even necessary to idealize the irrigation problem for better understanding its mechanisms and determinative aspects. A new attempt to define the volumetric sink term added to the continuity equation for soil-water flow and describing plant water uptake by roots is proposed. This sink function allows the introduction of plant parameters and the calculation of the actual transpiration rate as a function of time given a pedologic, climatic and cultural situation. This new definition considers physical principles that let us describe a given soil-plant system with more parameters. In this model, the volumetric sink term involves: (1) the potential transpiration rate; (2) a root distribution function specific to the geometry of the considered bulb; and (3) the soil suction dependent reducing factor, defined here in a fundamentally different way. Apart from the analysis of irrigation problems and devices for which this model is designed, one can easily use it to approach other problems related to the unsaturated zone like natural or artificial recharge of the groundwater table and its relations with vegetation. (Author's abstract)
W88-07192

SALT TOLERANCE IN THE HALOPHYTE SUAEDA MARITIMA L. DUM. GROWTH, ION EXCHANGE IN RESPONSE TO ALTERED SALINITY,
Sussex Univ., Brighton (England). School of Biological Sciences.
For primary bibliographic entry see Field 2L.
W88-07212

IONIC AND WATER RELATIONS RESPONSES OF TWO POPULATIONS OF A NON-HALOPHYTE TO SALINITY,
Duke Univ., Durham, NC. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W88-07216

COOL-SEASON TURFGRASS RESPONSES TO DROUGHT STRESS,
Rhode Island Univ., Kingston. Dept. of Natural Resources Science.
For primary bibliographic entry see Field 3F.
W88-07223

EFFECTS OF COMBINATIONS OF HEAVY METALS ON HILL ACTIVITY OF AZOLLA PINNATA,
Burdwan Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W88-07266

PHYSICALLY-BASED MODEL FOR THE AGROHYDROLOGIC PROCESSES,
For primary bibliographic entry see Field 2A.
W88-07560

COMPARISON OF TWO RECENT MODELS FOR ESTIMATING ACTUAL EVAPOTRANSPIRATION USING ONLY REGULARLY RECORDED DATA,
Department of Environmental Resources, Cook College, Rutgers University, New Brunswick, NJ 08903 (U.S.A.).
For primary bibliographic entry see Field 2D.
W88-07563

LAND-USE CHANGES AND WATER RESOURCES IN A KARSTIC MEDITERRANEAN REGION (EVOLUTION DE L'OCCUPATION DES TERRES ET RESSOURCES EN EAU EN REGION MEDITERRANEENNE KARSTIQUE),
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
For primary bibliographic entry see Field 4C.
W88-07567

GENOTYPIC RESPONSE TO SODIUM CHLORIDE SALINITY OF FOUR MAJOR OLIVE CULTIVARS (OLEO EUROPEA L.),
Dept. of Horticulture, Faculty of Agriculture, Aristotelian Univ., Thessaloniki, Greece.
For primary bibliographic entry see Field 3C.
W88-07636

EFFECTS OF SALINITY AND GIBBERELLIN ON WATER CONTENT, GROWTH AND MINERAL COMPOSITION OF COWPEA, CALABRESE AND RED RADISH PLANTS,
For primary bibliographic entry see Field 3C.
W88-07672

ALGAE WITH A TASTE FOR THE UNUSUAL,
School of Science at the University of Buckingham, England.
For primary bibliographic entry see Field 2H.
W88-07675

EFFECTS OF SIMULATED ACID RAIN ON LEAF WETTABILITY, RAIN RETENTION AND UPTAKE OF SOME INORGANIC IONS,
Bristol Univ. (England). Dept. of Agricultural Sciences.
For primary bibliographic entry see Field 5C.
W88-07689

EFFECTS OF SULPHUR DIOXIDE AND NITROGEN DIOXIDE ON THE CONTROL OF WATER LOSS BY BIRCH (BETULA SPP.),
Lancaster Univ. (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-07690

EFFECTS OF WATER DEFICIT ON VEGETATIVE GROWTH, FRUIT GROWTH AND FRUIT QUALITY IN COX'S ORANGE PIPPIN APPLE,
Ministry of Agriculture and Fisheries, Levin Horticultural Research Centre, Private Bag, Levin,

New Zealand.
For primary bibliographic entry see Field 3F.
W88-07692

EFFECT OF SOIL WATER POTENTIAL, METHOD OF IRRIGATION AND NITROGEN ON PLANT WATER RELATIONS, CANOPY TEMPERATURE, YIELD AND WATER USE OF RADISH,
Division of Soil Science, Indian Institute of Horticultural Research, Hessaraghatta Lake P.O., Bangalore-650089, India.
For primary bibliographic entry see Field 3F.
W88-07693

CHARACTERIZING WATER USE BY IRRIGATED WHEAT AT GRIFFITH, NEW SOUTH WALES,
Centre for Irrigation and Freshwater Research, Commonwealth Scientific and Industrial Research Organization, Griffith, N.S.W. 2680.
For primary bibliographic entry see Field 3F.
W88-07702

ECOLOGICAL RELATIONSHIPS OF WILD RICE, ZIZANIA AQUATICA: 7. SEDIMENT NUTRIENT DEPLETION FOLLOWING INTRODUCTION OF WILD RICE TO A SHALLOW BOREAL LAKE,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 4C.
W88-07946

EFFECTS OF A WATER-DEPTH GRADIENT ON THE GERMINATION OF LAKESHORE PLANTS,
Ottawa Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-07948

2J. Erosion and Sedimentation

SIZE DISTRIBUTION AND WET DENSITY OF SEDIMENT ERODED UNDER SIMULATED RAINFALL,
Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture.
K. Egashira, and S. Nakai.
Soil Science and Plant Nutrition, Vol. 33, No. 3, p 347-354, 1987. 5 tab, 10 ref.

Descriptors: *Sediment distribution, *Soil density, *Soil erosion, *Simulated rainfall, *Sediment transport, Surface flow, Cohesionless soils, Cohesive soils, Particle size, Erosion.

Masa soil and Red-Yellow soil (Japan) were compared in terms of the size distribution of the sediment (primary particles plus aggregates) eroded under simulated rainfall and of the wet density of the > 210 micrometer sediment that exists during the transport by surface flow. The sediment-size distribution for the Masa soil, which is generally coarse-textured and lacks cohesion, was monomodal showing a peak in the size range of 5-20 micrometers, and the eroded sediment consisted of both primary particles and aggregates. On the other hand, the largest peak in the sediment-size distribution for the Red-Yellow soil, which shows a relatively fine texture and high stability of aggregates, corresponded to the 210-2,000 micrometer size range irrespective of the monomodal or bimodal distribution. The sediment eroded from the Red-Yellow soil consisted mostly of aggregates. The wet sediment density was significantly higher for the > 210 micrometer sediment from the Masa soil than for the > 210 micrometer sediment from the Red-Yellow soil. This difference in wet sediment density may account for the difference in the transportability between the two sediments. (Author's abstract)
W88-06825

DROUGHT-RELATED CHANGES OF GEOMORPHOLOGIC PROCESSES IN CENTRAL MALI,
Smithsonian Institution, Washington, DC. Center for Earth and Planetary Studies.
For primary bibliographic entry see Field 2E.
W88-06841

BENTHIC ENERGY FLOW DURING A SIMULATED AUTUMN BLOOM SEDIMENTATION,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2L.
W88-06857

FATE OF ORGANIC CARBON AND NITROGEN IN EXPERIMENTAL MARINE SEDIMENT SYSTEMS: INFLUENCE OF BIOTURBATION AND ANOXIA,
Odense Univ. (Denmark). Biological Inst.
For primary bibliographic entry see Field 5B.
W88-06865

SUSPENDED SEDIMENT TRANSPORT, SEDIMENTATION, AND RESUSPENSION IN LAKE HOUSTON, TEXAS: IMPLICATIONS FOR WATER QUALITY,
Rice Univ., Houston, TX. Dept. of Geology and Geophysics.
J. M. Matty, J. B. Anderson, and R. B. Dunbar.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 3, p 175-186, 1987. 10 fig, 35 ref.

Descriptors: *Sediment transport, *Lakes, *Path of pollutants, *Erosion, *Suspended sediments, *Water quality, *Sedimentation, Lake Houston, Texas, Reservoirs, Rainfall, Wave effects, Water circulation, Wind waves, Organic matter, Coliforms, Trace metals, Heavy metals, Metals.

The influence of sedimentation and resuspension on water quality was studied in Lake Houston, a reservoir near Houston, Texas. Sediment input to the lake was dependent on the intensity of rainfall in the 7325 sq km watershed. Sediment movement and resuspension within the shallow lake were strongly affected by wave activity and by wind-driven circulation. Almost all samples from sediment traps at levels between 1 and 5 m contained very fine sand and medium to coarse silt, indicating that circulation is intense enough to suspend even particles of this size. The most rapid transport of suspended sediment (< 1 day) occurred in winter during sustained northerly winds of >5 m/sec. Increased residence time of suspended sediments allowed greater decomposition of organic matter and release of trace elements from sediments to water column. Organic carbon flux was positively correlated with sediment flux. Sediments which had the least degree of resuspension had the highest concentrations of trace metals. Coliform bacterial levels, which exhibit capricious distribution and timing in Lake Houston, may also be related to resuspension and sediment transport. (Cassar-PTT)
W88-06883

VARIABILITY OF THE METAL CONTENT OF FLOOD DEPOSITS,
Department of Geography, State University of Utrecht, The Netherlands.
For primary bibliographic entry see Field 5B.
W88-06887

TRANSPORT OF FINE-GRAINED SEDIMENTS IN SHALLOW WATERS,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
C. K. Ziegler, and W. Lick.
Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 123-132, February 1988. 7 fig, 16 ref.

Descriptors: *Path of pollutants, *Sediment transport, *Rivers, *Estuaries, *Suspended sediments, *Shallow water, Model studies, Raisin River, Sedimentation, Bottom sediments, Erosion, Water currents, Simulation.

A numerical model was developed and applied to the resuspension, deposition and transport of fine-grained sediments in (1) the Raisin River, a small polluted stream flowing into Lake Erie; (2) a river flowing into a lake or ocean with a cross-flow; and (3) a time-dependent flow in a simple estuary as affected by tidal currents. The model accurately described the sediment bed and the resuspension of the bottom sediments due to physical processes. Vertically integrated differential equations were used to approximate the hydrodynamic and sediment transport equations. A volume integral method was used to derive finite difference equations which are second-order accurate, explicit and locally conservative. In a simulation of sediments in the Raisin River 12 hr after a high flow, net erosion occurred where the currents were high and net deposition occurred in the rest of the river, especially in the turning basin. In the erosional areas the net resuspension was zero. In the case of the river flowing into a body of water with a cross current, erosion occurred in the river channel and in an area near the river mouth. Deposition occurred downstream of the eroded area with a very rapid increase in sediment thickness near the river mouth at the downstream edge of the eroded area. In a simple estuary case, net erosion occurred near the mouth of the estuary and a small net deposition occurred in the rest of the estuary. Deposition and resuspension were both high near the river mouth resulting in little net deposition. (Cassar-PTT)
W88-06890

MAGNITUDE-FREQUENCY RELATIONSHIP OF COASTAL SAND DELIVERY BY A SOUTHERN CALIFORNIA STREAM,
San Diego State Univ., CA.
D. W. Stow, and H. H. Chang.
Geo-Marine Letters, Vol. 7, No. 4, p 217-222, 1987. 5 fig, 1 tab, 12 ref.

Descriptors: *Model studies, *Sediment transport, *Sedimentation, *Streams, *Coastal streams, *Deltas, *Flood frequency, *Sand, Watersheds, Mathematical studies, Prediction, California, Floods.

Coastal sand delivery by a stream in southern California is estimated based on a numerical model which stimulates unsteady flow, sediment transport, and the associated channel adjustments for a stream-delta system. An average annual sediment yield of 51,400 cu m/yr is estimated for the San Dieguito River, which drains a semiarid watershed controlled by dams. Of the total sand delivery by the stream, 20.5 percent is contributed from floods greater than the 100-year flood; 17.6 percent from those between the 50- and 100-year events; 28.4 percent from those between the 25- and 50-year floods; and 33.6 percent from those smaller than the 25-year flood. (Author's abstract)
W88-07053

SUSPENDED SEDIMENT LOAD AND MECHANICAL EROSION IN THE SENEGAL BASIN--ESTIMATION OF THE SURFACE RUNOFF CONCENTRATION AND RELATIVE CONTRIBUTIONS OF CHANNEL AND SLOPE EROSION,
Centre de Sedimentologie et de Geochimie de la Surface, Institut de Geologie, Rue Blessig, 67084 Strasbourg Cedex, France.
Z. Kattan, J. Y. Gac, and J. L. Probst.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 59-76, June 30, 1987. 8 fig, 8 tab, 87 ref.

Descriptors: *Erosion, *Suspended sediments, *Hydrograph analysis, *Rivers, *Sediment transport, *Runoff, *Slope erosion, *Channel erosion, Senegal Basin, Model studies, Hydrologic models, Hydrographs, Subsurface drainage, Surface runoff, Groundwater.

Suspended sediment dynamics were studied in the Senegal Basin using a simple hydrological model which allows separation of the different flow components of the annual hydrograph. Data used in the analysis were derived from average monthly discharges and monthly suspended sediment concentrations (1979-1984) of the 1800-km Senegal River at Bakel gaging station, about 600 km from the river mouth. Average flow components (in

billions of cu m) for the five years were as follows: surface runoff, 1.45; subsurface flow, 2.11; and groundwater flow, 6.84. During the study period the mean annual flow (330 cu m/sec) represented only 46% of the mean long-term flow (1903-1984). Suspended sediment concentrations were generally highest in June-September (up to 721.6 mg/liter) in June, 1983, and lowest in March-May (minimum, 5.6 mg/liter). Average suspended sediment concentration for the 5-year study was 185 mg/liter. The mean yearly particulate load carried by the Senegal River was 1.9 million tons, a specific transport of 8.75 tons/sq km/year. Two approaches were used to estimate the different contributions to the river's suspended sediment transport. The main contribution originated from slope erosion, which supplied 50-80% of the total sediment transport, and the second originated from channel erosion. The suspended sediment concentration in the surface runoff, primarily calculated by a global annual method, ranged from 0.9 to 1.6 g/liter and averaged 1.3 g/liter. After correction for channel erosion input, this concentration was reduced to 1.1 g/liter. (Cassar-PTT)
W88-07108

ARCTIC PEDOGENESIS: 2. THRESHOLD-CONTROLLED SUBSURFACE LEACHING EPISODES,
Environmental Protection Agency, HW-113, Seattle, WA.
For primary bibliographic entry see Field 2G.
W88-07172

CONCEPTUAL CATCHMENT MODEL FOR ESTIMATING SUSPENDED SEDIMENT FLOW,
G. B. Pant University of Agriculture and Technology, Pantnagar 263 145, U. P., India.
S. Kumar, and R. A. Rastogi.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 155-163, 15 November 1987. 6 fig, 1 tab, 12 ref.

Descriptors: *Mathematical models, *Catchment areas, *Soil erosion, *Sediment yield, *Suspended sediments, *Sediment transport, Graphical analysis, Prediction, Continuity equation, Storm runoff, Excess rainfall, Rainfall-runoff relationships, Sediment concentration, Watersheds, Sediment load, Soil conservation, Reservoir silting, India.

A conceptual catchment model of the instantaneous unit sediment graph was developed for sediment graph prediction and to determine the effect of soil conservation measures on sediment flow for a mountainous watershed by routing mobilized sediment through a series of linear reservoirs. It is noteworthy that the model does not require that the geometric configuration of a given watershed be explicitly accounted for; the suspended sediment dynamics are represented by a spatially-lumped continuity equation and a linear storage law. The sediment graphs generated by convolution of the instantaneous unit sediment graph with mobilized sediment were compared with the natural observed ones on the Chaukhutia watershed comprising an area of 452 sq km of the Ramganga reservoir catchment. The mobilized sediment during a storm was related to rainfall excess and the parameters of the model were estimated utilizing fourteen sediment events observed during the years 1976-84. The close agreement between the computed sediment graphs and the observed graphs is very favorable. By means of this simple method of calculation in which a very limited number of parameters is involved, an accuracy is attained that more than satisfies the practical requirements. (Author's abstract)
W88-07199

BOAT TRAFFIC, SEDIMENT RESUSPENSION AND TURBIDITY IN A BROADLAND RIVER,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-07207

CRITERION FOR THE EFFECT OF SUSPENDED SEDIMENT ON NEAR-BOTTOM VELOCITY PROFILES,
Institute of Oceanographic Sciences, Taunton, United Kingdom.
R. L. Soulsby, and B. L. S. A. Wainwright.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 341-356, 1987. 5 fig, 24 ref.

Descriptors: *Sediment-water interfaces, *Flow profiles, *Bottom currents, *Sediment transport, *Streamflow, *Suspended sediments, Velocity curve, Flow velocity, Particle size, Flow friction, Shear stress, Ocean bottom.

The effect of suspended sediment on the shape of near-bottom velocity profiles has been investigated theoretically and in the laboratory by a number of authors. However, because the resulting expressions for the profile are generally complicated, such effects are often neglected by engineers analyzing measured profiles. A criterion for the conditions of flow velocity and sediment grain-size is presented under which it is permissible to neglect the sediment effects. Where it is not, an estimate of the resulting error in the friction velocity is given. A direct method is presented for obtaining the friction velocity (and hence bed shear-stress) from velocity profiles measured under mobile sediment conditions, which takes account of the suspended sediment effects. (Author's abstract)
W88-07248

DESIGN OF STABLE ALLUVIAL CHANNELS,
Hydraulics and Coastal Engineering Group, Kuwait Institute for Scientific Research, P. O. Box 24885, Safat, Kuwait.
For primary bibliographic entry see Field 2E.
W88-07252

NONLINEAR SOLUTION OF AGGRADATION AND DEGRADATION IN CHANNELS,
Detroit Water and Sewerage Dept., MI.
M. A. Gill.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 5, p 537-547, 1987. 4 fig, 8 ref.

Descriptors: *Channels, *Alluvial channels, *Sediment transport, *Channel erosion, *Soil, *Sediment-water interfaces, *Aggradation, *Degradation, *Mathematical models, Alluvial rivers, River beds, River flow, Differential equations.

Aggradation occurs in an alluvial river when the imposed sediment-supply rate exceeds the sediment-transport capacity of the flow; conversely, the flow tends to degrade the river channel when its sediment-transport capacity is in excess of the sediment-supply rate. A sediment-laden river flow is generally very complex and it is extremely difficult at present to develop analytical solutions for aggradation and degradation river processes. A perturbation solution is presented for the non-linear aggradation/degradation problem. Consider a stable sediment-transporting flow in a wide rectangular channel; at a given instant of time, its sediment-supply rate is suddenly perturbed (increased or decreased) at an upstream station. The first-order solution is a published previously linear solution the second-order solution presented accounts for the non-linear character of the aggradation/degradation equation. The predicted profiles were compared with the experimental results of Soni et al. The agreement between theory and experimental observations is good, especially for aggradation. The limiting curve for the extreme non-linear situation is within the usual scatter range of the linear solution indicating that in many situations, the linear solution by itself may provide reasonably accurate predictions. For the degradation problem, non-linear correction is needed in most cases. (Shidler-PTT)
W88-07253

SOME HYDROLOGIC IMPACTS OF PLOWING RANGELAND SOILS,
Utah State Univ., Logan. Watershed Science Unit.
For primary bibliographic entry see Field 4C.
W88-07291

COLORS OF GLACIER WATER,
For primary bibliographic entry see Field 2H.
W88-07446

TURBIDITY CURRENT SIMULATION IN A DIVERGING CHANNEL,
Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
J. Akiyama, and H. G. Stefan.
Water Resources Research WRERAO, Vol. 24, No. 4, p 579-587, April 1988. 11 fig, 31 ref. DOC Grant NA83-AA-D-00056.

Descriptors: *Model studies, *Sediment transport, *Density currents, *Turbidity currents, *Simulation, *Erosion, *Deposition, *Turbidity, Water currents, Spatial distribution, Mathematical studies, Equations, Sediments.

Spatially varied turbidity currents with erosion and deposition of sediment occurring in slightly diverging-sloping channels with a rectangular cross section were simulated. The model consists of cross section integrated equations for conservation of volume and mass, x momentum equation, and empirical relationships for water entrainment and sediment entrainment. The continuity equation for the sediment bed was coupled with the equations for the flow in order to simulate the change of bed elevation due to erosion and deposition of turbidity currents. The gradually varied flow equations were solved. The simulations show that (1) underflows in diverging channels do not reach a normal condition, (2) three different types of turbidity currents can be simulated, and (3) turbidity current behavior is sensitive to particle size, water viscosity, channel slope, as well as channel diverging angle when channel aspect ratio is small. (Author's abstract)
W88-07448

DEPRESSION OF PRIMARY PRODUCTION BY HUMIC MATTER AND SUSPENDED SEDIMENT IN LIMNOCORRAL EXPERIMENTS AT SOUTHERN INDIAN LAKE, NORTHERN MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W88-07638

USING LANDSAT MULTISPECTRAL SCANNER DATA TO ESTIMATE SUSPENDED SEDIMENTS IN MOON LAKE, MISSISSIPPI,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W88-07657

RELATIONSHIP OF GULLY SIDEWALL SHAPE TO SEDIMENT PRODUCTION,
Soil Conservation Service, Gunnedah (Australia).
R. J. Crouch.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 531-539, 1987. 3 fig, 1 tab, 13 ref.

Descriptors: *Erosion, *Gully erosion, *Bank erosion, *Water pollution sources, *Erosion rates, *Sediment sources, Gullies, Shape, New South Wales, Australia, Undercutting, Prediction, Geomorphology.

Reports of gully side erosion describe a range of side forms. The lack of information on the relative importance of the various forms in terms of sediment production hinders the identification of the major sediment sources within the gullies. Observations of gully sides in a catchment in New South Wales showed a range of side forms being eroded at significantly different rates. Side classification and measurement by survey and erosion pins showed that vertical sides, subject to undercutting, had the highest erosion rate (75 mm/year) followed by vertical fluted walls (37 mm/year). These different rates are critical in predicting present and future rates of erosion and identifying sediment sources within gully systems. (Author's abstract)
W88-07703

RAINFALL CONDITIONS AND EROSIVITY IN THE NJALA AREA OF SIERRA LEONE,
Department of Environmental Studies and Geography, Njala University College, University of Sierra Leone, Private Mail Bag, Freetown, Sierra Leone.
A. K. Bomah.
Journal of Environmental Management JEVMAW, Vol 26, No. 1, p 1-7, January 1988. 2 fig, 4 tab, 11 ref.

Descriptors: *Soil erosion, *Erosion, *Rainfall intensity, *Rainfall impact, *Rainfall-runoff relationships, Erosion rates, Energy intensity, Rainfall, Seasonal variation, Soil water, Infiltration, Sierra Leone, Dry farming, Correlation analysis, Soil loss, Kinetic energy.

Where there is marked seasonality of rainfall coupled with rainstorms of high intensity, an increase in soil erosion potential occurs where farming is practiced because the ground is devoid of vegetation for a period early in the growing season. The concentration of rainfall in short seasons is widespread in Sierra Leone. A wet period of high-intensity rainfall alternates with a long, dry period. Erosion potential becomes more severe because soil moisture levels in the wet season are high and the intensity of rains is often greater than infiltration. The rainfall properties in Sierra Leone are the major constraints of cropping practices and conservation measures. The rainfall characteristics and erosive ability in the Njala area of Sierra Leone were investigated. The Njala area is typical of large farming areas in West Africa, where farmlands are bare at the advent of the wet season. Three notable parameters normally used to measure rain erosivity were used. These include: the energy intensity value at its maximum 30-minute intensity (EI sub 30 index), an index developed for use in West Africa calculated by multiplying the cm of rainfall of a rainstorm by its 7.5-minute maximum intensity (AI sub m index), and the intensities $>$ 25 mm/hour ($K>1$). The AI sub m erosivity index was the best predictor in explaining soil erosion, even though wind was excluded from the computation. This index has the following advantages over the others: it takes into account maximum rain intensity and intense storms lasting over a period of time, it is simply computed, and it does not lower the maximum rainstorm intensity for short storms. Results of the correlation between the various indices and erosion generally revealed only slight relationships. On the whole, more significant relationships existed between rainfall and soil loss than between rainfall and runoff. (Wood-PTT)
W88-07710

HYDROLOGY AND SEDIMENT TRANSPORT IN SMALL WATERSHEDS,
Agricultural Research Service, Temple, TX. Grassland, Soil and Water Research Lab.
J. R. Williams.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 141-151, 38 ref.

Descriptors: *Small watersheds, *Sediment transport, *Hydrologic models, *Watersheds, Water quality, Model studies, Simulation analysis, Erosion, Rainfall-runoff models, Routing, Sediment yield, Sedimentation, Overland flow, Cycling nutrients, Pollutants.

Sediment transport models useful in water quality assessment can be divided into two broad categories according to the nature of the pollutant to be modeled (toxic or chronic). Single events are generally appropriate for toxic pollutants because excessive concentration may cause damage during a runoff event. Conversely, long-term simulation models are appropriate for estimating accumulations that cause chronic problems. Single event sediment transport models usually estimate upland erosion by rainfall and runoff and sediment transport in overland flow and channels. They are generally designed for routing sediment graphs and estimating the dynamics of particle-size distributions. Since the time scale is relatively short and routing is available, the spatial scale can be expanded to accomodate complex watersheds. Routing increases prediction accuracy on complex watersheds and allows determinations of subwatershed contributions to total sediment yield as well as locations and amounts of deposition and degradation. Long-term sediment simulation models generally do not have routing components, but require considerable computing time in maintaining a water balance and estimating crop and residue cover continuously. Because of these time-consuming processes and the usual long-term simulations, the spatial scale is usually limited to small, relatively homogeneous areas. However, long-term simulation models provide a means for evaluating the effects of agricultural management on sediment yield because they produce frequency distributions, not just single event amounts. They are capable of simulating crop growth, residue decay, nutrient cycling, soil temperature, and other factors that affect hydrology and erosion-sedimentation. It can be seen that the long-term simulation models are not very sensitive to errors in estimating initial conditions. (See also W88-07820) (Lantz-PTT)
W88-07829

POTENCY FACTORS AND LOADING FUNCTIONS FOR PREDICTING AGRICULTURAL NONPOINT SOURCE POLLUTION,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W88-07830

EROSION AND SEDIMENT YIELD: SOME METHODS OF MEASUREMENT AND MODELLING.
Geo Books, Regency House, Norwich (England). 1984. 218 p. Edited by R. F. Hadley and D. E. Walling.

Descriptors: *Erosion, *Sedimentation, *Erosion rates, *Soil erosion, *Sediment erosion, *Hydrologic models, *Sediment yield, Mathematical models, Regression analysis, Sediment transport, Suspended sediments, Sediment discharge, Sediment load, Dissolved solids, Reservoir silting, Mathematical studies, Model studies.

This book presents some methods of measuring erosion and sediment yield of solid matter and solutes in a variety of environments and land uses. Some methods are also presented for utilizing erosion and sediment yield data in the development of regression equations and mathematical models designed to improve predictive and estimation capabilities. The individual chapters assembled in this book include: (1) simple methods of measurement of upland erosion and sediment yield; (2) qualitative methods of estimating sediment yield; (3) methods of measurement of suspended load and bedload of streams; (4) measurement of dissolved loads in streams; (5) methods of measurement of reservoir sedimentation and trap efficiency; (6) empirical estimates of upland soil loss; and (7) modelling of sediment yield. The methods presented are representative of current research in the field of erosion and sediment transport. These methods are intended to be useful to scientists and engineers who are initiating research and data-collection programs concerned with erosion and sedimentation problems. (See W88-07896 thru W88-07903) (Geiger-PTT)
W88-07895

MEASURING AND PREDICTING SOIL EROSION,
Geological Survey, Denver, CO.
R. F. Hadley.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 1-14, 4 fig, 2 tab, 31 ref.

Descriptors: *Erosion, *Sediment yield, *Soil erosion, *Channel erosion, *Geomorphology, *Hydrologic models, *Sediment yield, *Mathematical models, Rainfall simulators, Sediment load, Sediment transport, Vegetation, Land use, Monitoring, Mathematical studies, Prediction, Scour, Runoff, Universal Soil Loss Equation, Catchment basins, Pacific Southwest Interagency Committee Method.

Many field methods have been developed to provide measurements of the quantity of soil that is eroded in a specific period of time. These measurements, together with data on precipitation, soil and vegetation characteristics, topography, and land use can be used to develop empirical relations for predicting of soil erosion and estimating sediment yield. Field experiments designed to measure soil erosion are generally conducted on small plots or drainage basins $<$ 5 sq km in size. Establishment of slope transects with a series of steel pins or nails has been frequently employed to measure erosion. Mass movement of the soil mantle can be measured by drilling rows of holes in the soil to a depth of 0.9 to 1.2 m and normal to the slope and along a contour. These holes are filled with glass beads. Excavation of the site at a later time will show any downslope movement of the soil mantle in cross section. Techniques for monitoring morphological changes in stream channels similar to those described for hillslopes can be easily installed at little expense. Channel cross section can be surveyed annually or at any desired interval to monitor erosion, aggradation, and changes in channel position in the floodplain. In small basins where reservoirs have been constructed, data can be collected at the reservoir on runoff and sediment yield by using the reservoir as a gaging station. The Universal Soil Loss Equation is now the most widely used equation for soil loss prediction. Rainfall simulators help to collect soil-loss data rapidly and allow control of the duration and intensity of rainfall. The Pacific Southwest Interagency Committee (PSIAC) method is a simple qualitative method for evaluating sediment yield. The PSIAC method involves the qualitative rating of a drainage basin based on nine factors that represent surface geology, soils, climate, runoff, vegetation, land use, and erosion characteristics. Estimates of sediment yield made with the PSIAC method correlated closely with measured sediment yields. (See also W88-07895) (Geiger-PTT)
W88-07896

SOIL LOSS ESTIMATION: A MODELLING TECHNIQUE,
Institute of Agricultural Engineering, Harare (Zimbabwe).
H. A. Elwell.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 15-36, 6 fig, 6 tab, 4 ref.

Descriptors: *Soil erosion, *Mathematical models, *Zimbabwe, *Sheet erosion, *Erosion, *Hydrologic models, Rainfall impact, Interception, Seasonal distribution, Topography, Slopes, Model studies, Crop production, Vegetation, Rainfall intensity, Mathematical models.

The Soil Loss Estimator for Southern Africa (SLEMSA) model was used to estimate annual soil losses due to rainfall from arable lands on the Zimbabwe highveld. The model was devised to estimate soil losses from sheet erosion arising from the agricultural practices on the land between the terraces. The SLEMSA model has been incorporated into a design procedure to develop safe farming systems for arable lands. The model was built from a limited amount of field plot data supplemented by expert opinion from a multidisciplinary team of specialists. The SLEMSA model rates field practices in order of erosion hazard and gives good predictions of absolute soil loss for a wide range of common cropping conditions on the Zimbabwe highveld. Five control variables were identified in the Zimbabwe program: seasonal rainfall energy; the amount of rainfall energy intercepted by the crop; soil erodibility; slope length; and slope percent. Although the SLEMSA model is in a relatively early stage of development, it has performed sufficiently well in comparative field tests. Steps are being taken to improve its weakest point, the submodel for fallow conditions, and provide a better quantitative definition of the soil erodibility based on research data. (See also W88-07895) (Geiger-PTT)
W88-07897

MEASUREMENT OF SEDIMENT YIELDS,
Ward (Peter) and Associates, Vancouver (British Columbia).
P. R. B. Ward.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 37-70, 15 fig, 3 tab, 45 ref.

Descriptors: *Sediment yield, *Sediment load, *Fluvial sediments, *Suspended sediments, *Sediment erosion, *Hydrologic data, *Sampling, Stream gages, Sediment transport, Bed load, Bed-load discharge, Mathematical models, Mathematical studies, Settling velocity, Sedimentation, Tracers, Errors.

The standard approach used by most government agencies for measuring sediment yield is to establish permanent stations at river sites where the amount of sediment passing that station (unit weight per day) is measured either periodically, or continuously. Periodic measurements are suitable for determining mean values averaged across the cross-section. Continuous methods rely on the operation of a device that monitors suspended sediment concentrations, usually at a single point near the bank. An alternative direct approach to measuring sediment yields is to monitor the accumulation of sediment deposits on the beds of reservoirs and at delta fronts. These measurements are usually carried out seasonally and are thus only suitable for determining annual totals. Amounts of sediment are measured as volumes and accompanying measurements of density must be made if accumulated weights of sediment are to be found. The finest fraction of the sediment is not measured by this method as this fraction remains in suspension and either passes through the reservoir and out over the spillway or, in the case of coastal deltas, passes out to sea. The use of the river gaging station in sampling sediment transport is described. Errors incurred in suspended sediment sampling may be calculated by mathematical expressions. Manual and mechanical methods of withdrawal of single samples for measuring suspended sediments are described. Several samplers have been developed by the United States Federal Interagency Sedimentation Project for sampling suspended sediment from many points across a river section. Bed load samplers are also described. Tracing of bed load movement may be carried out using naturally occurring contrasts in bed material characteristics or using artificial labelling. Suspended sediments may be determined in the laboratory by filtration, light tranmissibility, sieving, and electrolytic techniques. (See also W88-07895) (Geiger-PTT)
W88-07898

SEDIMENT YIELD MODELLING,
Agricultural Research Service, Morris, MN.
C. A. Onstad.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 71-89, 40 ref.

Descriptors: *Sediment yield, *Sediment erosion, *Hydrologic models, *Management planning, *Simulation, *Mathematical models, *Model studies, *Statistical models, Storm erosion, Storm runoff, Water quality, Mathematical studies, Slopes, Rainfall-runoff relationships, Stochastic process, Temporal distribution, Erosion.

Sediment yield models vary considerably to accomodate the wide range of water resources problems where sediment yield estimates are needed. These water resources problems have been categorized as follows: (1) erosion control planning, (2) water resources planning and design, and (3) water quality modelling. The simplest models are generally used in erosion control planning where only the mean sediment yield is needed. However, more complex models have been developed and used to estimate sediment yields from individual storms. Certain water resource planning activities and water quality modelling usually require simulation. Here the time sequence of sediment yield is included. Modelling the time sequence of sediment yield requires a more general formulation involving time distributions of sediment producing rainstorms, runoff events, or of the sediment yield events themselves. The selection of the proper model to be used for a particular problem depends on many factors including the available data and the risk involved. (See also W88-07895) (Author's abstract)
W88-07899

MEASUREMENT OF BEDLOAD IN RIVERS,
Geological Survey, Denver, CO. Water Resources Div.
W. W. Emmett.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 91-109, 4 fig, 5 tab, 17 ref.

Descriptors: *Sediment sampler, *Sediment transport, *Bed load, *Sampling, *Bottom sediments, *Sediment yield, Fluvial sediments, Erosion, Bed-load discharge, Sediment erosion, Hydraulic efficiency, Alaska, Idaho, Rivers.

The Helley-Smith bed load sampler is a direct-measuring sampler intended for use in rivers with flow velocities up to 3 m/s and with sediment sizes up to medium gravel. Its pressure-difference design creates excessive hydraulic efficiency, about 150%; apparently this does not affect greatly the sediment-trapping efficiency of the sampler. Sediment-trapping characteristics of the Helley-Smith bed loader sampler were studied by comparing sediment transport rates as measured with the Helley-Smith sampler with those measured utilizing an open slot constructed across a streambed. Basic data indicate that the Helley-Smith bed load sampler, for the majority of sediment sizes available in the study, is 90 to 100% efficient, but efficiency decreases somewhat with increases in transport rate. Modifications of the basic data to normalize the data sets and correct for statistical procedures indicate that the trap efficiency is 100 to 110% and varies little with changes in transport rate. Recommended procedure for using the Helley-Smith bed load sampler requires about 20 equally spaced, cross-channel sampling locations. Each location is sampled for a duration of 30 to 60 seconds on each of two separate traverses across the river. This procedure enables determination of mean bed load transport rate, as well as providing insight into spatial and temporal variations in transport rates. The Helley-Smith bed load sampler has been used to measure bed load in a variety of rivers ranging in channel size from less than 4 m wide to more than 6000 m wide, and transporting bed load ranging in size from medium sand to coarse gravel. Use of the sampler to measure bed loads for the Tanana River in Alaska and the Snake and Clearwater Rivers in Idaho is described. (See also W88-07895) (Author's abstract)
W88-07900

DISSOLVED LOADS AND THEIR MEASUREMENT,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-07901

MEASUREMENT OF RESERVOIR SEDIMENTATION,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
D. L. Rausch, and H. G. Heinemann.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 179-200, 13 fig, 1 tab, 15 ref.

Descriptors: *Sedimentation, *Sediment erosion, *Reservoir silting, *Sampling, *Surveys, *Reservoirs, *Sediment yield, *Sediment sampler, Mathematical studies, Sediment discharge, Distribution patterns, Sediment distribution, Bottom sediments, Sounding, Sediment transport, Sediment concentration, Surveying instruments, Water depth records, Piston corers, Trap efficiency.

An efficient method for making a good reservoir sedimentation survey and the procedure for determining the sediment yield from a watershed are described. Equipment and manpower needs, safety precautions, computational methods, suggested analyses of sediment samples, and other components needed to complete a sedimentation survey are described. Accuracy problems associated with many past reservoir sedimentation surveys can be avoided by systematic procedures and techniques. Each reservoir must be considered individually and its base line and range layout carefully planned before the survey begins. A plane table and alidade can be used to map readily and accurately the exposed deltaic deposits, spillway and shoreline contours and range ends. Use of an engineer's level is suggested for vetical control. A sonic depth recorder electrically pulsed by a switch on the cable meter can be used to automatically plot water depth versus distance as it is moved across the reservoir on each range. Manual sounding techniques may also be used to record depth. A gamma probe can be used to measure the volume-weight of the saturated deposited sediment in place. A piston type sampler can be used to remove an undisturbed sample for further determination of its physical properties. Reservoir capacity is best determined by the stage-area curve method. The average-contour method can be easily adapted to computer use to determine capacities and sediment volumes and distribution. Sediment accumulation should be expressed as a total weight of sediment. Sediment yield can be determined from the deposited sediment weight by applying a reservoir sediment trap efficiency value to account for the sediment that passed through the reservoir. (See also W88-07895) (Geiger-PTT)
W88-07902

RESERVOIR TRAP EFFICIENCY,
Agricultural Research Service, Beltsville, MD. Hydrograph Lab.
For primary bibliographic entry see Field 8A.
W88-07903

SEDIMENTS OF ICE-DAMMED, SELF-DRAINING APE LAKE, BRITISH COLUMBIA,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W88-07937

SEDIMENTATION IN ICE-DAMMED HAZARD LAKE, YUKON,
Alberta Univ., Edmonton.
D. G. E. Liverman.
Canadian Journal of Earth Sciences CJESAP, Vol.

Descriptors: *Iced lakes, *Glacial lakes, *Lake ice, *Glaciers, *Sedimentation, *Lake sediments, *Limnology, Drainage, Steele Glacier, Seasonal variation, Melting, Sands, Gravel, Drainage-filling cycle, Yukon, Canada.

Hazard Lake, located in Kluane National Park, the Yukon, is an ice-dammed lake formed in 1966 by the surge of the Steele Glacier. Since 1975 it has drained annually by means of a subglacial tunnel. During July 1979, observations were made of lake processes before drainage and of sections described in the lake bottom after drainage. Three facies associations are believed to represent prelake, stable lake, and annual draining phases. Gravel commonly found at the base of sections represents deposition in a braided fluvial system prior to 1966. Lake sediments deposited between 1966 and 1975 are dominantly graded laminated silt deposited by turbid underflow from the major inflow stream. Lamination is probably caused by diurnal underflow events or daily variation in strength of underflow. No 'winter' clay component of varved sediments is observed. During drainage a regressive sequence is deposited as the lake level drops, with sand-dominated sediments overlapping laminated silt where the main inflow stream enters the lake. This is followed by local fluvial deposition along the course of the reestablished stream. During filling a transgressive sequence is deposited as the lake level rises. Sand-dominated deltaic sedimentation is followed by deposition from underflow, resulting in laminated and massive silt and clay. These fine-grained facies separate sand facies and demark individual filling events but are easily

eroded. Thus it is not possible to identify the effects of each individual drainage-filling cycle in the sediments. After drainage the lake remains empty until the next melt season, during which time a braided stream is established in the lake basin, depositing sands and gravels and eroding lake sediments. (Author's abstract)
W88-07939

HOLOCENE ALLUVIAL GEOLOGY AND GEOARCHAEOLOGY OF THE SAN XAVIER REACH OF THE SANTA CRUZ RIVER, ARIZONA,
Texas A and M Univ., College Station. Dept. of Anthropology.
M. R. Waters.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 4, p 479-491, April 1988. 11 fig, 1 tab, 31 ref.

Descriptors: *Geologic history, *Geomorphology, *Alluvial channels, *Archaeology, *Paleohydrology, *Arroyos, Fluvial sediments, Braided streams, Reach, Arizona, Cienegas, Dunes, Santa Cruz River, Hohokam settlement.

The 15-km segment of the Santa Cruz River, traversing the San Xavier Indian Reservation, near Tucson, Arizona, has undergone major environmental changes during the past 8000 yr. The Holocene alluvial sequence for this segment, called the San Xavier reach of the Santa Cruz River, shows three major episodes: aggradation until 8000 yr B.P. by a braided stream; channel erosion from 8000 to 5500 yr B.P.; and subsequent vertical aggradation of the flood plain, punctuated by short periods of arroyo cutting. The major changes in the fluvial regime were probably the result of climatic changes, but cycles of arroyo cutting and filling during the past 2,500 yr were probably the result of unstable internal geomorphic conditions, flooding, and human impacts on the flood plain. The alluvial history of the San Xavier reach had a pronounced effect on the preservation of archaeological remains Environmental changes on the flood plain, including arroyo cutting and filling, cienega formation and destruction, and sand-dune development, led to the disruption and reorganization of Hohokam settlement and subsistence patterns between 1150 and 500 yr B.P. (Author's abstract)
W88-07952

EROSION-PRODUCTIVITY ECONOMICS MODEL: A USER'S GUIDE,
Economic Research Service, Temple, TX. Resources and Technology Div.
M. R. Dicks, C. T. Osborn, D. E. Kugler, and J. H. Reisen.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-229878. Price codes: A04 in paper copy, A01 in microfiche. 46 p, 5 fig, 10 tab, 3 ref, 3 append.

Descriptors: *Erosion, *Productivity, *Economic aspects, *Model studies, *Soil productivity, Crop budget, Economic aspects, Tillage.

The Erosion-Productivity Economics Model (EPEM) was developed by USDA's Economic Research Service to help policy analysts estimate and evaluate long-term economic effects of erosion-induced productivity changes. This microcomputer-based mathematical program integrates information from many different sources. These include outputs from the Erosion-Productivity Impact Calculator (EPIC), the Erosion-Productivity Impact Simulator as well as the partial enterprise budgeting system and other production economics information developed for the 1985 Resources Conservation Act (RCA) by Iowa State University's Center for Agricultural and Rural Development in conjunction with the U.S. Department of Agriculture's Soil Conservation Service. EPEM's output allows static comparisons of estimated revenues, costs, net returns, and erosion rates for specified management systems, such as crops in rotation, tillage method, and soil conservation practice by Major Land Resource Area (MLRA) and by RCA soil group. Revenues and costs are estimated for the years 1980 and 2030 as a function of yield. Estimates of the changes in yields over the 50-year period are based on cumulative gross erosion funcitons from EPIC simulations. Employing present value theory, EPEM calculates net return values for a 50-year period, allowing the user to compare alternative management systems within or between RCA soil groups and MLRA's. For illustration purposes sample crop udgets, prices, yields, and erosion levels for 12 Major Land Resource Areas, 4 conservation tillage practices, and 4 land groups were developed. (Lantz-PTT)
W88-07967

2K. Chemical Processes

CHANGES OF WATER TEMPERATURE, PH, DISSOLVED OXYGEN, INORGANIC NITROGEN, AND PHOSPHORUS CONCENTRATIONS IN FLOWING IRRIGATION WATER ON PADDY SURFACE,
First Laboratory of Soil and Fertilizer, Environment Div., Chugoku Nat. Agricultural Experiment Station, Fukuyama, Hiroshima, 721 Japan.
For primary bibliographic entry see Field 5B.
W88-06827

OXIDATION OF SULFUR DIOXIDE BY OZONE IN HIGHLY DISPERSED WATER DROPLETS,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
T. M. Nahir, and G. A. Dawson.
Journal of Atmospheric Chemistry , Vol. 5, No. 4, p 373-383, December 1987. 3 fig, 1 tab, 21 ref. NSF Grant ATM-82-15694.

Descriptors: *Chemical reactions, *Oxidation, *Sulfur dioxide, *Ozone, *Acid rain, *Acidic water, *Fluid drops, *Cloud liquid water, Clouds, Rate constants, Sulfur compounds, Hydrogen ion concentration.

The oxidation of S(IV) by ozone in aqueous solution was studied in highly dispersed droplets in a laboratory cloud chamber at 20 degrees C. Urban air was used. Ozone concentrations ranged from 15 to 120 ppb, orders of magnitude lower than most previous works. Rate constants were derived from differential product determination, rather than from rates of decay of bulk reactants. Comparison of these results with those from previous work indicates that the reaction rate is first order with respect to ozone. The second-order reaction rate constants found in this work lay between, or close to, other recent results, and could be represented by: $k = 12300\ (H(+)\ \text{to the minus } 0.51\ \text{power})/M/\text{second}$. (Author's abstract)
W88-06876

TRACE METAL DYNAMICS IN A SEASONALLY ANOXIC LAKE,
Freshwater Biological Association, Ambleside (England).
K. Morfett, W. Davison, and J. Hamilton-Taylor.
Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 107-114, February 1988. 5 fig, 3 tab, 27 ref.

Descriptors: *Geochemistry, *Eutrophic lakes, *Lakes, *Seasonal variation, *Anoxia, *Heavy metals, Metals, Trace elements, Iron, Manganese, Organic carbon, Cadmium, Copper, Lead, Zinc, Hydrogen ion concentration, Sediments, Lake sediments, Esthwaite Water, England, Oxygen deficit, Sediment-water interfaces, Seasonal variation.

Dissolved concentrations of Fe, Mn, organic carbon, Cd, Cu, Pb, Zn, and pH were determined in the water column and interstitial waters of Esthwaite Water, a seasonally anoxic lake. Sampling was done on 39 occasions throughout a 12-month period. Trace metals concentrations were low throughout the year in both water column and pore water. Some remobilization appeared to occur at the sediment-water interface, but sediments deeper than 3 cm acted as a sink throughout the year. Variations in metals levels were largely associated with increased loading during periods of heavy rainfall. During summer, concentrations of Cu and Zn in the waters overlying the sediments were higher because of release from decomposing algae. Enhanced concentrations of Cd, Cu, Pb, and Zn were seen during periods of much reduced mixing during ice cover. Dissolved and particulate Fe and Mn levels had large seasonal variations, but these did not influence trace metal concentrations. (Cassar-PTT)
W88-06888

DIRECT AND INDIRECT PHOTOLYSIS OF WATER-SOLUBLE AZODYES: KINETIC MEASUREMENTS AND STRUCTURE-ACTIVITY RELATIONSHIPS,
SRI International, Menlo Park, CA. Chemistry Lab.
For primary bibliographic entry see Field 5B.
W88-06944

PRODUCTS OF HEXACHLOROCYCLOPENTADIENE (C-56) IN AQUEOUS SOLUTION,
Geochemistry Section, Illinois State Geological Survey, Champaign, Illinois 61820.
For primary bibliographic entry see Field 5B.
W88-06945

LABORATORY STUDIES ON MECHANISMS FOR THE DEGRADATION OF ALDICARB, ALDICARB SULFOXIDE AND ALDICARB SULFONE,
Wisconsin Univ., Madison. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W88-06946

CASE AGAINST MERCURY (II) METHYLATION BY AQUATIC ENVIRONMENTAL METHYLSILOXANES,
Health and Environmental Sciences Department, Dow Corning Corporation, Midland, Michigan 48686-0994.
For primary bibliographic entry see Field 5B.
W88-06952

DUAL-LABEL RADIOISOTOPE METHOD FOR SIMULTANEOUSLY MEASURING BACTERIAL PRODUCTION AND METABOLISM IN NATURAL WATERS,
George Mason Univ., Fairfax, VA. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W88-07024

DECAY OF DISSOLVED SUBSTANCES BY SECOND-ORDER REACTION; PROBLEM DESCRIPTION AND BATCH-REACTOR SOLUTIONS,
U. S. Salinity Lab. Soil and Water Management Research Unit, Riverside, CA 92521.
For primary bibliographic entry see Field 5B.
W88-07073

MEASUREMENTS OF SPECIFIC RATES OF NET METHYL MERCURY PRODUCTION IN THE WATER COLUMN AND SURFACE SEDIMENTS OF ACIDIFIED AND CIRCUMNEUTRAL LAKES,
Manitoba Univ., Winnipeg. Dept. of Microbiology
For primary bibliographic entry see Field 2H.
W88-07081

PHOSPHORUS SPECIES IN THE SURFICIAL SEDIMENTS OF LAKES OF EASTERN NORTH AMERICA,
Biology Department, Allegheny College, Meadville, PA 16335, USA.
For primary bibliographic entry see Field 2H.
W88-07084

MICROBIAL COMMUNITIES ON LEAF MATERIAL PROTECTED FROM MACROINVER-

TEBRATE GRAZING IN ACIDIC AND CIRCUMNEUTRAL STREAMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W88-07089

INFLUENCE OF COMPLEXATION AND PH ON INDIVIDUAL AND COMBINED HEAVY METAL TOXICITY TO A FRESHWATER GREEN ALGAE,
Department of Fisheries and Oceans, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Canada Centre for Inland Waters, Burlington, Ont. L7R 4A6.
For primary bibliographic entry see Field 5C.
W88-07096

NUMERICAL MODEL FOR THE FORMATION OF SALINE WATERS DUE TO DIFFUSION OF DISSOLVED NA CL IN SUBSIDING SEDIMENTARY BASINS WITH EVAPORITES,
Louisiana State Univ., Baton Rouge. Dept. of Geology.
V. Ranganathan, and J. S. Hanor.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 97-120, June 30, 1987. 10 fig, 42 ref.

Descriptors: *Geochemistry, *Saline water, *Model studies, *Sedimentary basins, *Evaporites, *Subsidence, Brine, Mass transport, Solute transport, Pore water, Dissolved solids, Diffusion, Convection, Finite difference method, Mathematical modeling, Geohydrology.

Numerical modeling by a finite difference method, incorporating the effects of vertical variations in pressure, temperature, salinity, and porosity, shows that mass transport by diffusion may be a major brine-forming process in sedimentary basins containing halite beds. Vertical fluxes of dissolved NaCl are greatest when the subsidence rate is slow. At subsidence rates of 20 m/m.y, more than 250 m of salt can be dissolved over 150 m.y. At rapid subsidence rates, such as 500 m/m.y, pore waters are advected downward so rapidly that although a diffusion front develops above the evaporite, this front moves downward as the evaporite subsides, and diffusive fluxes at shallow depths are thus low. However, under such conditions, the pore water column becomes gravitationally unstable as a result of thermally-induced density inversions and the potential for convective overturn is enhanced with accompanying advective salt flux upward. Although dissolution and diffusion of NaCl are important processes in the burial history of evaporites, they are not adequate by themselves to produce the regional salinity versus depth profiles that are actually observed in some sedimentary basins. Diffusion-induced gradients progressively increase with depth whereas gradients actually observed in sedimentary basins tend to decrease with depth. The difference is presumably due to the activity of other mass transport mechanisms such as advection, convection, and dispersion. (Author's abstract)
W88-07110

TRIBUTYLTIN (TBT) IN THE WATERS OF A SCOTTISH SEA LOCH ARISING FROM THE USE OF ANTIFOULANT TREATED NETTING BY SALMON FARMS,
DAFS Marine Laboratory, P.O. Box 101, Victoria Road, Aberdeen AB9 8DB (Great Britain).
For primary bibliographic entry see Field 5B.
W88-07117

CONTINUOUS-FLOW DETERMINATION OF MANGANESE IN NATURAL WATERS CONTAINING IRON,
Institute of Oceanographic Sciences, Brook Road, Wormley, Godalming, Surrey GU8 5UB (Great Britain).
For primary bibliographic entry see Field 7B.
W88-07121

ENVIRONMENTAL CHEMISTRY OF ZINC IN HIMALAYAN SEDIMENTS,
Division of Soil Science, Sher-e-Kashmir University of Agricultural, Science and Technology, Shalimar Srinagar-Kashmir, India.
For primary bibliographic entry see Field 2H.
W88-07132

RADIOACTIVE TRACER TECHNIQUES IN SPECIATION STUDIES,
Oslo Univ. (Norway). Dept. of Chemistry.
B. Salbu.
Environmental Technology Letters ETLEDB, Vol. 8, No. 8, p 381-392, August 1987. 5 fig, 31 ref.

Descriptors: *Radioactive tracers, *Tracers, *Trace elements, *Speciation analysis, *Microchemistry, *Water quality, *Water pollution, *Aquatic environments, *Norway, Natural waters, Water pollution, Radionuclides.

Chemically well-defined radioactive tracers are useful for the investigation of the physico-chemical forms of trace elements as well as radionuclides present in natural waters. The technique is particularly applicable to the analytical fractionation methods used in speciation studies. Furthermore, tracer techniques are ideal for the study of microchemical phenomena (e.g. colloid formation, solid-water interactions). The handling of small amounts of elements in solution is well established within radiochemistry and may be directly applied to speciation studies. The information from tracer studies cannot be extrapolated with confidence to long-term, large-scale, natural conditions because the distribution of radioisotopes added to the system may not reflect that of the stable element originally present. (Miller-PTT)
W88-07141

ACID DROPS PROJECT: POLLUTION MONITORING BY YOUNG PEOPLE,
Field Studies Council, Epping Forest Conservation Centre, High Beach, Loughton, Essex IG10 4AF.
C. H. Thomson.
Biological Journal of the Linnean Society BJLSBG, Vol. 32, No. 1, p 127-135, September 1987. 3 fig, 8 ref.

Descriptors: *Acid rain, *Pollution monitoring, *Research, Rainfall, Research studies, Weather data.

A project was launched by the Advisory Centre for Education (ACE), Cambridge, in 1971. Following publicity in a Sunday Times article, 10,000 Clean Water Kits were distributed to young people throughout the U.K. Each kit contained the necessary study material to identify chosen freshwater indicator species, such as stonefly nymphs, freshwater shrimps and blood worms. Using these bioindicators and notes on the presence or absence of fish, clean water streams were distinguished from three other categories of polluted water. The success of the ACE surveys gave rise to a permanent young people's environmental club called 'Watch', which is now the junior wing of the Royal Society for Nature Conservation. The sheer numbers and enthusiasm of young, environmentally concerned people, makes possible the gathering of information on a far wider scale than can be professionally achieved. The acid drops method was a happy compromise between the de-mystification of science, and standard rainfall chemistry collection procedure. Two thousand kits were distributed, and an estimated 10,000 young people were involved in collecting acid rain records during January and February 1985. Fifty percent of record forms were completed, less than the 80% for the Clean Water project, but considerably more than the 10% for the Air Pollution project, suggesting a high level of interest and conscientiousness. The weather picture was in fact straightforward. A stagnating high pressure air stream had been sitting over industrial Europe, picking up pollutants and blocking the progression of the prevalent south westerlies. The movement of this air body westwards, would allow the pollutant filled air mass to be drawn into the easterly frontal systems affecting the country at the time. The easterly airstream therefore, brought cold, wintry, polluted weather. The Acid Drops survey successfully demonstrated the general meteorological link with acidity patterns over the U.K., using a standard technique of known error, and on a wider scale than was previously possible. (Alexander-PTT)
W88-07155

CATION DEPLETION RATE AS A MEASURE OF SOIL SENSITIVITY TO ACIDIC DEPOSITION: THEORY,
Department of Ecology and Environmental Research, Swedish University of Agricultural Sciences, S-750 07, Uppsala, Sweden.
For primary bibliographic entry see Field 2G.
W88-07163

HUMAN GLUTATHIONE PEROXIDASE ACTIVITY IN CASES OF HIGH SELENIUM EXPOSURES,
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 5C.
W88-07169

DISSOLVED IRON AND ORGANIC MATTER IN NORTHERN PEATLANDS,
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
Soil Science SOSCAK, Vol. 145, No. 1, p 70-76, January 1988. 4 fig, 2 tab, 39 ref.

Descriptors: *Path of pollutants, *Iron, *Chemical properties, *Iron, *Dissolved solids, *Fens, *Peat bogs, Peat soils, Organic carbon, Iron compounds, Colloids, Canada.

Concentration of dissolved (passing through aerobic filtration) iron and organic carbon (DOC) were determined in water samples collected from subarctic fens near Schefferville and boreal bogs near Sept-Iles, northern Quebec. Total iron and DOC concentrations averaged 19.3 and 1.2 mg/L, respectively, for all the samples analyzed and were weakly negatively correlated. The bog waters were higher in DOC and lower in total iron than the fen waters. Subsurface samples from the fens, underlain by iron-rich materials, showed increased iron concentrations, whereas the bogs, underlain by iron-poor materials, did not. Differences in the DOC:iron ratios can be explained by the different pathways of water and sources of DOC and iron in the two types of peatland. Reaction of the peat water samples with o-phenanthroline suggests both organically complexed and fine colloidal and dissolved forms of iron. The continuous variation method showed that peak absorbance occurs at DOC:iron ratios of 6:1 to 8:1, suggesting that all but the subsurface fen samples contained organic matter complexes that were undersaturated with respect to iron. (Author's abstract)
W88-07174

UNSUITABILITY OF WORLD HEALTH ORGANISATION GUIDELINES FOR FLUORIDE CONCENTRATIONS IN DRINKING WATER IN SENEGAL,
Department of Human Nutrition, Agricultural University, Wageningen, The Netherlands.
For primary bibliographic entry see Field 3C.
W88-07213

IONIC AND WATER RELATIONS RESPONSES OF TWO POPULATIONS OF A NON-HALOPHYTE TO SALINITY,
Duke Univ., Durham, NC. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W88-07216

ESTIMATING THE ATMOSPHERIC INPUT OF POLLUTANTS INTO A WATERSHED,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5B.
W88-07256

COMPARISON OF EXCESS SULFATE YIELDS AND MEDIAN PH VALUES OF RIVERS IN NOVA SCOTIA AND NEWFOUNDLAND, 1971-1973 AND 1982-1984,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
For primary bibliographic entry see Field 5B.
W88-07257

SUMMARY OF THE IMPACT OF ACID RAIN ON ATLANTIC SALMON (SALMO SALAR) IN CANADA,
Fisheries Research Branch, Halifax, Nova Scotia B3J 2S7, Canada.
For primary bibliographic entry see Field 5C.
W88-07258

INFLUENCE OF PH ON THE TOXICITY OF ALUMINIUM AND OTHER INORGANIC CONTAMINANTS TO EAST COAST STRIPED BASS,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W88-07263

SPECIFIC SORPTION OF TRACE AMOUNTS OF CU, PB, AND CD BY INORGANIC PARTICULATES,
Newcastle Univ. (Australia). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-07269

GROUND WATER QUALITY PREDICTION USING CLIMATIC INDICES,
North Texas State Univ., Denton. Dept. of Geography.
K. M. McGregor, G. A. Marotz, and D. O. Whittemore.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 43-48, February 1988. 5 fig, 2 tab, 14 ref.

Descriptors: *Drought, *Water quality, *Water chemistry, *Prediction, *Mineralization, *Groundwater recharge, Meteorological data collection, Indexing, Palmer index, Eagleman Aridity Index, Aquifers, Correlation analysis, Kansas.

Drought affects the quality of ground water in certain aquifers used by municipalities in Kansas. Water quality changes occur as a function of the amount of water available for recharge and hence to dilute more mineralized ground waters. Several measures of meterological drought, including the Palmer Index and Eagleman Aridity Index, were correlated with water quality data to determine the degree of association. Several locations showed sharp declines in water quality as the drought progressed. The relationships can be used to predict possible variations in present and future well-water supplies in locations subject to drought-induced water quality deterioration. (Author's abstract)
W88-07276

HYDROCHEMISTRY OF GROUNDWATER AT UNIQUE OUTLETS OF THE BET SHEAN-HAROD MULTIPLE-AQUIFER SYSTEM, ISRAEL,
Research Division, Hydrological Service of Israel, P.O. Box 6381, Jerusalem 91063.
E. Rosenthal.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 75-87, January 15, 1988. 2 fig, 3 tab, 21 ref, append.

Descriptors: *Water quality, *Geochemistry, *Aquifer characteristics, *Geohydrology, Outlets, Basalts, Carbonates, Source aquifers, Geology, Groundwater movement, Israel, Brines, Geologic fractures.

The Bet Shean and Harod Valleys are regional recipients and mixing zones for groundwater draining to these valleys from a multiple-aquifer system which includes carbonate and basalt aquifers and deep-seated reservoirs of brine. The outlets of these aquifers are located at the mountain border separating the valleys from the Gilboa and Ramot Issakhar Mountains. The aquifers drain through two types of outlets, unique and common. The latter type is mainly conditioned by the occurrence of fault blocks acting as connecting media between the aquifers. Groundwater flowing to the unique outlets of the carbonate aquifers are usually of bicarbonatic-calcic composition whereas those reaching the outlets of basalt aquifers are of chloridic-sodic assemblage. Ionic ratios of groundwaters flowing through different carbonate aquifers do not have sufficient contrast to facilitate precise identification of source aquifers. In the case of basalt aquifers, the ratios are unequivocal and sufficient contrast enables such an identification. (See W88-07300 thru W88-07301) (Author's abstract)
W88-07299

TOWARDS ESTABLISHING ALUMINIUM HYDROXY SILICATE SOLUBILITY RELATIONSHIPS FOR NATURAL WATERS,
Institute of Hydrology, Wallingford (England).
C. Neal, and R. J. Williams.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 347-352, February 15, 1988. 4 fig, 14 ref.

Descriptors: *Acid waters, *Acidity, *Leaching, *Aluminum, *Aluminosilicates, *Solubility, *Disequilibrium models, Bedrock, Mineral water, Correlation studies, Hydraulic models, Catchments, Wales, Stoichiometry, Trace metals, Chemical properties.

A mineral disequilibrium model has been developed for amorphous aluminosilicates that is potentially of value in studies of aluminium solubility controls in such catchments as streams, bedrock, and soils. This technique has been applied to a study of the streams draining the coniferous Hafren forest of mid-Wales. It is shown using the data obtained from the Hafren forest study and from published experimental observations that more detailed information on the aluminosilicate system is required before the use of such disequilibirum models can be justified. Effective use of the models requires independent measurement of the composition of the natural aluminosilicates involved. Linear relationship between the log of the solubility activity quotient (Q) and pH appears to be an artifact in that it assumes a linear relationship between the stoichiometric fraction (x) and pH. The composition of aluminosilicate minerals precipitating in the soil and stream waters may well be influenced by hyrological as well as chemical factors, and cannot assume simple Gibbsite (Al(OH)3) solubility. (Friedmann-PTT)
W88-07315

DETERMINING ULTRATRACE METAL CONCENTRATIONS BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROMETRY,
Oakland Univ., Rochester, MI. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-07384

PROCESSES AFFECTING THE DISTRIBUTION OF SELENIUM IN SHALLOW GROUNDWATER OF AGRICULTURAL AREAS, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA.
For primary bibliographic entry see Field 5B.
W88-07441

DEUTERIUM IN WATER VAPOR ABOVE THE ATMOSPHERIC BOUNDARY LAYER,
City Coll., New York. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2B.
W88-07479

ALUMINUM SPECIATION IN ACIDIC NATURAL WATERS: TESTING OF A MODEL FOR AL-HUMIC COMPLEXATION,
Freshwater Biological Association, The Ferry House, Ambleside, Cumbria LA220LP, United Kingdom.
For primary bibliographic entry see Field 5B.
W88-07543

CHARACTERIZATION OF SALINE GROUNDWATER RESOURCE QUALITY FOR AQUATIC BIOMASS PRODUCTION: A STATISTICALLY-BASED APPROACH,
Solar Fuels Division, Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401.
For primary bibliographic entry see Field 3C.
W88-07550

DISTRIBUTION OF ENVIRONMENTAL CHLORIDE IN RELATION TO SUBSURFACE HYDROLOGY,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2F.
W88-07571

PEATLAND WATER CHEMISTRY IN CENTRAL ONTARIO IN RELATION TO ACID DEPOSITION,
Canadian Wildlife Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W88-07599

REGIONAL PATTERNS OF SULFUR RETENTION IN WATERSHEDS OF THE EASTERN U.S.,
Northrop Services, Inc., Corvallis, OR.
B. P. Rochelle, and M. R. Church.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 61-73, November 1987. 4 fig, 4 tab, 38 ref.

Descriptors: *Geochemistry, *Claciology, *Paleohydrology, *Paleolimnology, *Sulfur compounds, *Watersheds, Path of pollutants, Regional analysis, Acid rain, Limnology, Deposition, Streams, Reservoirs, Lakes.

Retention of S was estimated in watersheds of the Eastern U.S. by calculating S input-output budgets for 678 lake and reservoir watershed systems in the Northeast (NE), 98 lake and reservoir and 61 stream systems of the Southern Blue Ridge Province (SBRP) and 56 stream systems of Shenandoah National Park (SNP). Budgets were determined based on estimates of deposition and output (as surface water) for each of the sites. A variety of estimates of total S deposition were used. Percent S retention is high for sites in the SBRP and SNP but is distributed around zero for sites in the NE. These findings lend support to the hypothesis that patterns exist in S retention relative to the extent of the Late Wisconsinan glaciation. (Author's abstract)
W88-07609

COMPOSITION OF ACIDIC MELTWATERS DURING SNOWMELT IN THE SCOTTISH HIGHLANDS,
Dept. of Oceanography, The Univ., Southampton S09 5NH, U.K.
For primary bibliographic entry see Field 5B.
W88-07610

NUMERICAL CLASSIFICATION OF SALINE GROUNDWATER CHEMISTRY IN THE MURRUMBIDGEE IRRIGATION AREA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2F.
W88-07699

CHEMICAL PROCESSES AND TRANSPORT OF PHOSPHORUS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-07825

ATMOSPHERIC DEPOSITION OF NUTRIENTS AND PESTICIDES,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-07826

DISSOLVED LOADS AND THEIR MEASUREMENT,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-07901

EFFECTS OF SLUDGE PROPERTIES ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W88-07906

ELECTRICAL CONDUCTIVITY AND SALINE CONCENTRATIONS IN ARID LAND GROUNDWATERS,
Department of Geography, The University, Nottingham, NG7 2RD, UK.
For primary bibliographic entry see Field 2F.
W88-07914

EARLY DIAGENESIS OF AMINO ACIDS AND ORGANIC MATTER IN TWO COASTAL MARINE SEDIMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2L.
W88-07918

STUDY OF SULPHUR ENRICHMENT IN THE HUMIC FRACTION OF MARINE SEDIMENTS DURING EARLY DIAGENESIS,
British Columbia Univ., Vancouver. Dept. of Oceanography.
R. Francis.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 1, p 17-27, January 1987. 10 fig, 8 tab, 5 ref.

Descriptors: *Diagenesis, *Sulfur, *Humic acids, *Enrichment, *Isotope fractionation, *Estuarine sediments, *Bioturbation, Redox boundary, Sulfidic boundary, Suboxic boundary, Marine sediments, Fjords, Isotope studies, Sulfur isotopes, Oxidation-reduction potential.

The evolution of the sulfur content of humic acids extracted from a near-shore sediment core obtained in Jervis Inlet, British Columbia, a typical fjord, was investigated. Special attention was taken to avoid S contamination of the humic materials during extraction. The S/C ratios increased continuously with depth to values which strongly suggest S addition to the humic matrix during early diagenesis by reactions between organic matter and H2S or its oxidation products. Their isotopic composition supports this view, however, subsequent isotopic exchange has obscured the mechanism initially involved. Since a large fraction of the enrichment occurred above the sulfidic zone, redox boundaries, such as the interface of anoxic microniches within more oxidized zones, or the sulfidic/suboxic boundary of the sediment column, must have been important sites for S addition. Bioturbation, by increasing the contact between sedimentary zones of a different redox regime, it will likely enhance such processes. (Author's abstract)
W88-07919

STRONTIUM ISOTOPIC EVOLUTION OF OIL-FIELD WATERS FROM CARBONATE RESERVOIR ROCKS IN BINDLEY FIELD, CENTRAL KANSAS, U.S.A.
Department of Geology, Kansas State University, Manahattan, KS 66506, USA.
S. Chaudhuri, V. Broedel, and N. Clauer.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 1, p 45-53, January 1987. 5 fig, 3 tab, 26 ref.

Descriptors: *Oil fields, *Geochemistry, *Hydrogeology, *Rock properties, *Minerals, *Strontium radioisotopes, *Carbonate rocks, *Diagenesis, *Water analysis, Chemical evolution, Mineral-water interactions, Kansas, Isotope studies, Calcium, Strontium, Sodium, Potassium, Rubidium, Lithium, Magnesium, Chlorine, Bromine.

Oil-field waters produced from Mississippian carbonate reservoir rocks in Bindley field, Kansas had an average salinity of about 42.8 mg/l. They were enriched in Ca, Sr, Na, K, Rb, and Li and depleted in Mg relative to sea water at the same level of either Cl or Br concentration. The average abundances of different elements are as follows: Na - 13,460 mg/l, K - 325mg/l, Rb - 0.9 mg/l, Li - 12 mg/l, Ca - 1,515 mg/l, Sr - 42 mg/l, Mg - 430 mg/l, Cl - 23,000 mg/l, SO4 - 2,630 mg/l, Br - 32 mg/l. The super Sr87/Sr86 values of the waters ranged between 0.7221 and 0.7230, whereas the values of the host carbonate rocks were between 0.7090 and 0.7093. The very high Sr87/Sr86 values of the waters probably occurred as a result of their reaction with alkali feldspar minerals in buried Precambrian crystalline rocks to the east of the Bindley field. Despite their residence in carbonate reservoir rocks oil-field waters can retain sufficiently distinct isotopic memory that may provide important clues about mineral-water interactions in the chemical evolutionary history of the waters. The study further indicates that very late diagenetic reactions in many carbonate rocks are of minor extent. Difference in the Sr isotopic data among the oil-field waters suggest that the Sr isotopic data can be used as a reliable guide in recognizing existence of separate pools in an oil field. (Author's abstract)
W88-07920

CELESTITE (SRSO4(S)) SOLUBILITY IN WATER, SEAWATER AND NACL SOLUTION,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. J. Reardon, and D. K. Armstrong.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 1, p 63-72, January 1987. 8 fig, 7 tab, 28 ref.

Descriptors: *Geochemistry, *Celestite, *Strontium compounds, *Seawater, *Saline water, *Brines, *Solubility, *Chemical analysis, *Mathematical equations, *Temperature effects, Sodium chloride, Pitzer relations, Saturate solutions, Thermodynamics, Minerals.

Celestite solubility measurements conducted in pure water at temperatures from 10 to 90 C. Equilibrium was achieved with respect to a crystalline solid phase from both undersaturated and supersaturated solutions. The measurements show that the solubility undergoes a maximum near 20 C. Log K (solubility product) values for the solubility reaction are adequately described by a mathematical expression as a function of temperature range 283.15 to 363.15 K. Thermodynamic values for the dissolution reaction of SrSO4(S) at 25 C were derived. Celestite solubility measurements were also determined in NaCl solutions up to 5 molal concentration and from 10 to 40 C. These data are in good agreement with the previous work of Strubel, who reported solubility measurements to temperatures of 100 C. The application of the Pitzer relations and solubility constants determined in this study to calculate celestite solubility in NaCl solutions yields excellent agreement between predicted values and experimental measurements over the entire range of temperature and NaCl concentration conditions. For the limited number of solubility measurements in seawater-type solutions and mixed-salt brines, the agreement using the Pitzer relations is within 3% of the measured solubility. (Author's abstract)
W88-07921

NOBLE GAS COMPOSITION OF DEEP BRINES FROM THE PALO DURO BASIN, TEXAS,
Bendix Field Engineering Corp., Grand Junction, CO.
For primary bibliographic entry see Field 2F.
W88-07922

SOLID/SOLUTION INTERACTION: THE EFFECT OF CARBONATE ALKALINITY ON ADSORBED THORIUM,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2H.
W88-07923

AMINO ACID ADSORPTION BY CLAY MINERALS IN DISTILLED WATER,
Washington Univ., Seattle. School of Oceanography.
J. I. Hedges, and P. E. Hare.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 2, p 255-259, February 1987. 1 fig, 1 tab, 38 ref.

Descriptors: *Amino acids, *Clay minerals, *Distilled water, *Kaolinite, *Montmorillonite, *Adsorption, *Electrostatic interactions, Alkalinity, Acidity, Natural water.

The adsorption of 15 protein amino acids from dilute (approx. 10 micromolar) distilled water solutions onto organic-free kaolinite and montmorillonite clay minerals (1 wt% suspensions) was determined at room temperature over a 48 h period. The systems came to steady state within 2 h. Basic (positively charged) amino acids were strongly adsorbed (40-80% removal) by both clay minerals. Neutral (uncharged) amino acids were taken up appreciably (10-15%) by montmorillonite, but little if any (<5%) by kaolinite. Acidic (negatively charged) amino acids were adsorbed (20-35%) only by kaolinite. These adsorption patterns appear to be related in part to electrostatic interactions between the clay mineral surfaces and the different amino acid types. The measured extents and selectivities of adsorption onto these clay minerals are sufficiently great to potentially affect the distributions and reactions of free amino acids in natural environments. (Author's abstract)
W88-07924

DIAGENETIC CHANGES OF LIGNIN COMPOUNDS IN A MORE THAN 0.6 MILLION-YEAR-OLD LACUSTRINE SEDIMENT (LAKE BIWA, JAPAN),
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W88-07925

SEASONAL DISTRIBUTIONS AND TURNOVER OF REDUCED TRACE GASES AND HYDROXYLAMINE IN YAQUINA BAY, OREGON,
Oregon State Univ., Corvallis. Coll. of Oceanography.
For primary bibliographic entry see Field 2L.
W88-07926

FACTORS AFFECTING PORE WATER HYDROCARBON CONCENTRATIONS IN PUGET SOUND SEDIMENTS,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W88-07927

ALUMINUM CHEMISTRY: FRACTIONATION, SPECIATION, AND MINERAL EQUILIBRIA OF SOIL INTERSTITIAL WATERS OF AN ALPINE WATERSHED, FRONT RANGE, COLORADO,
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.
For primary bibliographic entry see Field 5B.
W88-07928

BIOGEOCHEMICAL MASS BALANCE OF PO210 AND PB210 IN AN OLIGOTROPHIC LAKE WITH SEASONALLY ANOXIC HYPOLIMNION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-07929

PROCESSES AND KINETICS OF CD(2+) SORPTION BY A CALCAREOUS AQUIFER SAND,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-07930

CONTINENTAL WEATHERING OF GERMANIUM: GE/SI IN THE GLOBAL RIVER DISCHARGE,
Lamont-Doherty Geological Observatory, Palisades, NY.
R. A. Mortlock, and P. N. Froelich.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 8, p 2075-2082, August 1987. 5 fig, 3 tab, 40 ref.

Descriptors: *River flow, *Weathering, *Adsorption, *Geochemistry, *Minerals, *Solute transport, *Dissolved solids, Germanium, Silicon, Catchment areas, Seasonal variation, Clays, Rock properties.

Rivers display Ge/Si ratios ranging from 0.0000003 to 0.0000012, significantly lower than the average continental crustal composition (Ge/Si = 0.0000013) and do not, in general, display Ge/Si ratios reflecting that of the mineralogy in their drainage basins. In addition, seasonal changes in dissolved Ge/Si ratios are dramatic (a factor of 3). These observations suggest the operation of a bulk fractionation process(es) during weathering and transport of dissolved Ge and Si to the oceans which discriminates against soluble Ge. Buffering of Ge and Si by sorption onto riverine clays and surficial iron hydroxides may be important in controlling dissolved Ge and Si concentrations at Ge/Si ratios lower than crustal averages. The natural dissolved Ge to Si ratio carried to the sea by rivers averages about 0.0000006 plus or minus 10%. (Author's abstract)
W88-07931

MOLECULAR WEIGHT OF AQUATIC FULVIC ACIDS BY VAPOR PRESSURE OSMOMETRY,
Geological Survey, Denver, CO. Water Resources Div.
G. R. Aiken, and R. L. Malcolm.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 8, p 2177-2184, August 1987. 5 tab, 36 ref.

Descriptors: *Fulvic acids, *Water chemistry, *Rivers, *Chemical properties, Vapor pressure osmometry, Tetrahydrofuran, Humic acids, Molecular structures, Calcium, Magnesium, Cations.

The molecular weights of aquatic fulvic acids extracted from 5 rivers were determined by vapor pressure osmometry (VPO) with water and tetrahydrofuran (THF) as solvents. The values obtained ranged from 500 to 950 daltons, indicating that the molecular weights of aquatic fulvic acids are not as great as has been suggested in some other molecular weight studies. The samples were shown to be relatively monodisperse from radii of gyration measurements determined by small angle x-ray scattering. THF affords greater precision and accuracy than H2O in VPO measurements, and was found to be suitable solvent for the determination of molecular weight of aquatic fulvic acid because it obviates the dissociation problem. An inverse correlation was observed with these samples between the concentration of Ca(++) and Mg(++) in the river water and the radii of gyration and molecular weights of the corresponding fulvic acid samples. (Author's abstract)
W88-07932

MODELLING CHEMICAL EQUILIBRIA OF ACID MINE-DRAINAGE: THE FESO4-H2SO4-H2O SYSTEM,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W88-07933

ORIGIN OF SALT IN COASTAL MARSHES OF HUDSON AND JAMES BAYS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W88-07940

NITROGEN CYCLING IN A FORESTED MINNESOTA BOG,
Environmental Engineering Program, Civil and Mineral Engineering Department, University of Minnesota, Minneapolis, MN 55455, USA.
For primary bibliographic entry see Field 2H.
W88-07947

OPTICAL ABSORBANCE OF DISSOLVED ORGANIC MATTER IN NATURAL WATER STUDIES USING THE THERMAL LENS EFFECT,
Chemistry Dept., Concordia University, 1455 West de Maisonneuve Boulevard, Montreal, Quebec, Canada H3G 1M8.
J. F. Power, and C. H. Langford.
Analytical Chemistry ANCHAM, Vol. 60, No. 9, p 842-846, May 1, 1988. 3 fig, 2 tab, 18 ref.

Descriptors: *Colorimetry, *Water analysis, *Organic matter, *Humic substances, *Dissolved solids, *Organic carbon, Spectrometers, Absorption, Optical properties.

The thermal lens spectrometer described in this paper is applied to colorimetric determination of dissolved organic matter (humic substances) from a series of natural waters. The detection limit corresponds to dissolved organic carbon (DOC) less than 300 microgram/L at a wavelength of 600 nm. As is expected for thermal detection of absorbance, there is no interference in the measurement from light scattering; sample filtration is not necessary. Analysis of the absorbance parameter e sub 4/e sub 5, which characterizes humic materials, shows that it is independent of light scattering but may be related to donor-acceptor complex formation in the polymers. (Author's abstract)
W88-07949

IDENTIFICATION OF THE POSITION AND THE STEREOCHEMISTRY OF THE DOUBLE BOND IN MONOUNSATURATED FATTY ACID METHYL ESTERS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY OF DIMETHYL DISULFIDE DERIVATIVES,
Laboratoire de Physique at Chimie Mariens, Universite Pierre et Marie Curie, UA CNRS No. 353, tour 24, 4 Place Jussieu, 75252 Paris Cedex 05, France.
For primary bibliographic entry see Field 7B.
W88-07950

SR-ISOTOPIC EVIDENCE FOR DISCRETE SALINE COMPONENTS IN STRATIFIED GROUND WATERS FROM CRYSTALLINE BEDROCK, OUTOKUMPU, FINLAND.
Institute for Energy Technology, Box 40, 2007, Kjeller, Norway.
For primary bibliographic entry see Field 2F.
W88-07951

TRACE RARE EARTH ELEMENT ANALYSIS IN BRINY GROUNDWATERS,
Battelle Pacific Northwest Labs., Richland, WA. Chemical Technology Dept.
For primary bibliographic entry see Field 2F.
W88-07981

2L. Estuaries

TIDAL RECTIFICATION IN LATERAL VISCOUS BOUNDARY LAYERS OF A SEMI-ENCLOSED BASIN,
Centre for Mathematics and Computer Science, P.O. Box 4079, 1009 AB Amsterdam, The Netherlands.
H. E. De Swart, and J. T. F. Zimmerman.
Journal of Fluid Mechanics JFLSA7, Vol. 184, p 381-397, November 1987. 4 fig, 11 ref.

Descriptors: *Tides, *Advection, *Mathematical models, *Tidal basins, *Tidal hydraulics, *Boundary layers, *Mathematical studies, Viscous flow, Mathematical equations, Vortices, Reynolds number, Stokes numbers, Strouhal number.

The rectified flow, induced by divergence of the vorticity flux in lateral oscillatory viscous boundary layers along the sidewalls of a semi-enclosed basin, is studied as a function of the Strouhal number, kappa, equivalent to the Reynolds number of the viscous inner oscillatory boundary layer, and of the Stokes number. The squared ratio of these numbers defines another Reynolds number, measuring the strength of the self-advection by the residual flow. For strong self-advection the residual current decays to zero in an outer boundary, its width being large compared to the width of the inner layer. The regimes of small, moderate and strong self-advection are analyzed. (Author's abstract)
W88-06820

PREDICTION OF TIDAL SURGE IN LOWER CHESAPEAKE BAY,
Delaware Univ., Newark. Coll. of Marine Studies.
J. E. Moses, and C. Blair.
Journal of Waterway, Port, Coastal, and Ocean Engineering JWPED5, Vol. 114, No. 2, p 248-255, March 1988. 3 fig, 3 tab, 10 ref.

Descriptors: *Tidal surges, *Mathematical models, *Mathematical analysis, *Prediction, *Tides, *Chesapeake Bay, *Surges, *Wind tides, *Pressure distribution, Tidewater, Navigation, Pore hurricane surge model, Mathematical equation.

Tidal surge is the difference between observed water level and predicted astronomical tide. At present, surge predictions for Sewell's Point, Virginia, rely on Pore's hurricane surge model, a linear combination of forecast surface pressures over a large portion of the Atlantic Ocean. The authors have developed a variation on this method by including previous surge, local wind, and local pressure terms with time lags of up to 18 h to predict local daily surge. Surge prediction equations were derived for three substations 15-120 km (8-65 nautical miles) from Sewell's Point. Surge predictions at all four stations were improved at least 23% by the new regression equations. The ease in using the new equations and their improved accuracy make these new equations preferable to the Pore prediction method. This procedure is especially useful to shippers, property owners, and others with limited data sources. (Author's abstract)
W88-06853

FISH AND MACROCRUSTACEAN USE OF SUBMERGED PLANT BEDS IN TIDAL FRESHWATER MARSH CREEKS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W88-06854

GRAZING OF CILIATED PROTOZOA ON FREE AND PARTICLE-ATTACHED BACTERIA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
L. J. Albright, E. B. Sherr, B. F. Sherr, and R. D. Fallon.
Marine Ecology Progress Series MESEDT, Vol. 38, No. 2, p 125-129, June 18, 1987. 1 tab, 31 ref.

Descriptors: *Protozoa, *Bacteria, *Tidal rivers, *Salt marshes, Tidewater, Grazing, Dyes, Tracers, Nutrition, Foods.

The grazing preference of natural assemblages and of isolated species of ciliated protozoa for free or for particle-attached bacteria were tested. Bacterivorous ciliates were obtained from tidal creek water and from the surface flocculent layer of Spartina salt marsh sediments. Free and particle-attached bacteria were prepared by growing a Gram-negative, rod-shaped bacterium either in a nutrient solution, or on the surfaces of artificially made alginate beads containing the same nutrients.

The free and particle-attached bacteria were stained with a fluorescent dye and offered separately to ciliates in trace amounts (5% of the natural bacterial abundance of 1000000 to 10 to the 7th power cells/milliliter). Uptake of fluorescently labeled bacteria (FLB) by ciliates was monitored over 30 to 60 minute periods. All ciliates tested, except for a Euplotes sp. isolated from marsh floc, fed equally well or better on free FLB than on attached FLB. The marsh floc ciliates showed a stronger preference for attached bacteria than did tidal creek ciliates. Small spirotrichous ciliates and a free-swimming peritrich present in creek water ingested free FLB at rates 12 to 36 times greater than found for attached FLB. The experimental results indicate that bacterivorous ciliates are capable of feeding on free bacteria at bacterial abundance less than 10 to the 7th power cells/milliliter, and may not, as presently though, be confined to grazing attached of aggregated bacteria in natural waters. (Author's abstract)
W88-06855

OXYGEN PRODUCTION AND CONSUMPTION ASSOCIATED WITH THE MAJOR AUTOTROPHIC COMPONENTS IN TWO TEMPERATE SEAGRASS COMMUNITIES,
College of William and Mary, School of Marine Science, Gloucester Point, Virginia 23062.
L. Murray, and R. L. Wetzel.
Marine Ecology Progress Series MESEDT, Vol. 38, No. 3, p 231-239, July 13, 1987. 3 fig, 3 tab, 31 ref. EPA Grants R805974 and X003245.

Descriptors: *Sea grasses, *Oxygen requirements, *Oxygen production, *Nearshore processes, *Bays, Oxygen, Plant physiology, Plankton, Seasonal variation, Organic matter.

Oxygen production and consumption rates were determined for the various communities (plankton, sediment, and seagrass-plus-epiphytes) associated with 2 adjacent seagrass communities located on the southeastern shore of the Chesapeake Bay, Virginia; one was dominated by Zostera marina and the other by Ruppia maritima. Annual estimates of gross production summed for all communities were high compared to other reports (ca 1600 gC/sq m and 1100 gC/sq m in the Z. marina and the R. maritima dominated communities, respectively). Plankton and sediment communities accounted for 45 and 36% in the 2 areas, respectively. Seasonal patterns of production for the 2 areas differed. In the Z. marina area, plankton and sediment production dominated during summer, whereas in the R. maritima area production of seagrass (plus epiphytes) dominated throughout the study. Temporal trends for oxygen production and consumption of the plankton and sediment components corresponded closely and suggest direct in situ utilization. However, a lag observed between production and consumption in the seagrass-plus-epiphyte component indicates indirect utilization mediated by microbially dominated decomposition and demineralization processes. The ratio of annual gross production to dark respiration (P:R) exceeded 1.0 in both seagrass communities and for all components, suggesting net export and/or burial of carbon in these systems. (Author's abstract)
W88-06856

BENTHIC ENERGY FLOW DURING A SIMULATED AUTUMN BLOOM SEDIMENTATION,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
G. Graf.
Marine Ecology Progress Series MESEDT, Vol. 39, No. 1, p 23-29, July 27, 1987. 5 fig, 2 tab, 35 ref.

Descriptors: *Diatoms, *Eutrophication, *Sedimentation, *Sediments, *Benthos, Chemocline, Anaerobiosis, Benthic metabolism, Algae, Organic matter, Simulation, Oxygen requirements, Heat production, Energy, Energy flow equation.

Sedimentation of an autumn diatom bloom and its effect on sediment was simulated in the laboratory. Benthic response was similar to that observed in previous field studies: (1) a response within hours, (2) a rise of the chemocline, and (3) a change to pronounced anaerobiosis. Benthic metabolism was affected down to at least 7 cm sediment depth. Significantly more organic matter was consumed than was added by the diatoms. Sediment oxygen consumption explained <3% of the organic matter used, while heat production explained 89% of the burned material integrated over 7 cm sediment depth. The geochemical model of oxidizing organic matter is criticized. Development of ATP-biomass was in phase with the observed pattern of heat production. Efficiency of benthic response (P/C) was 50 to 60% in the surface and <40% in deeper sediment strata. The energy flow equation fitted within a range of 10%. (Author's abstract)
W88-06857

PHYTOPLANKTON BIOMASS AND NUTRIENT DYNAMICS IN A TIDALLY INDUCED UPWELLING: THE ROLE OF THE NO3:SIO4 RATIO,
Maurice-Lamontagne Institute, Department of Fisheries and Oceans, PO Box 1000, 850 route de la Mer, Mont-Joli, Quebec G5H 3Z4, Canada.
M. E. Levasseur, and J.-C. Therriault.
Marine Ecology Progress Series MESEDT, Vol. 39, No. 1, p 87-97, July 27, 1987. 10 fig, 3 tab, 38 ref.

Descriptors: *Estuarine environment, *Phytoplankton, *Nutrient dynamics, *Nutrients, *Upwelling, Biomass, Ocean circulation, Limiting nutrients, St. Lawrence estuary, Estuaries, Nitrates, Silicic acid, Algae, Water circulation.

Data from 2 cruises in July 1979 and 1980 in the head region of the Laurentian Channel, in the St. Lawrence estuary, were used to study variations of nutrient and phytoplankton biomass following upwelling relaxation. During both cruises, the newly upwelled water mass was characterized by high salinity (>29%), low temperature (<4 degrees C), low phytoplankton biomass (<1 microgram;liter) and high nutrient levels (NO3 = 13 micromolar, PO4 = 1.4 micromolar, SiO4 = 18 micromolar, NH4 = 0.6 micromolar). As the water mass warmed up, phytoplankton biomass increased exponentially up to approximately 17 micrograms/liter and a concurrent decrease in the concentration of all nutrients was observed. The decrease of NO3:PO4 and NO3:SiO4 ratios during this period indicates a gradual nitrate impoverishment of the mixed layer. At the warmest stations, in July 1980, nitrate and ammonium reached undetectable concentrations while silicic acid concentrations fell below 2 micromolar. High values of phytoplankton particulate organic carbon: particulate organic nitrogen (POC:PON) ratios measured in July 1980 also suggest that algae were nitrogen limited during this cruise. Data from this study and other world-wide upwelling areas support the hypothesis that the initial concentration of nitrate and silicic acid in the newly upwelled waters is the factor which mainly determines which nutrient will become exhausted (limiting) first. The nearly simultaneous exhaustion of nitrate and silicic acid in the St. Lawrence estuary is attributed to the 3-layer circulation pattern of its water masses. Silicic acid is trapped in the bottom layer (deeper than 100 m) which is hardly mixed with surface waters. In the intermediate layer (between 20 and 100 m), the origin of the upwelled waters, these 2 nutrients are generally found in equal proportion. (Author's abstract)
W88-06858

EXPERIMENTAL APPROACH TO QUANTIFY BIOLOGICALLY MEDIATED DISSOLVED SILICATE TRANSPORT AT THE SEDIMENT-WATER INTERFACE,
Nederlands Inst. voor Onderzoek der Zee, Texel.
W. Helder, and F. O. Andersen.
Marine Ecology Progress Series MESEDT, Vol. 39, No. 3, p 305-311, September 10, 1987. 5 fig, 2 tab, 33 ref. Danish Natural Science Research Council for FOA Grants 11-332 and 11-5298.

Descriptors: *Sediment-water interfaces, *Silicates, *Coastal waters, *Sediments, Fauna, Dissolved solids, Fluctuations, Bay of Fundy, Canada, Wadden Sea, Denmark, Interfaces, Tracers, Coasts.

Fluxes of dissolved silicate (diss. Si) across the sediment-water interface were measured by incubating cores from the Bay of Fundy, Canada, and the Dutch Wadden Sea. The influence of infauna on diss. Si transport was estimated by inactivation of infauna with formalin poisoning and 'asphyxiation'. Release of diss. Si in the Bay of Fundy ranged from 2.2 to 6.9 millimoles (mmol) Si/sq m/day (temperature 18 to 22 degrees C) before, and from 0.7 to 2.5 mmol/sq m/day after fauna inactivation. In the Dutch Wadden Sea these data were -1.2 to 21.3 and -0.05 to 9.7 mmol diss. Si/sq m/day (temperature 13.5 to 20 degrees C), respectively. Effect of formalin-poisoning and 'asphyxiation' compared well. With only one exception fluxes of diss. Si after inactivation of sediment fauna approached, within a factor of 2, fluxes calculated form pore-water gradients by assuming that molecular diffusion is the only transport mechanism for diss. Si exchange. (Author's abstract)
W88-06859

INTERACTIONS OF AMMONIUM, NITRATE, AND D- AND L-AMINO ACIDS IN THE NITROGEN ASSIMILATION OF TWO SPECIES OF ESTUARINE BENTHIC DIATOMS,
University of Groningen, Department of Marine Biology, PO Box 14, 9750 AA Haren (Gn), The Netherlands.
W. Admiraal, C. Riaux-Gobin, and R. W. P. M. Laane.
Marine Ecology Progress Series MESEDT, Vol. 40, No. 3, p 267-273, October 28, 1987. 4 fig, 1 tab, 32 ref.

Descriptors: *Diatoms, *Nitrogen assimilation, *Estuarine environment, Ammonium, Nitrates, Amino acids, Algae, Chromatography, Estuaries, Benthic flora, Aquatic plants, Benthos, Ions, Interstitial water.

Assimilation of D- and L-Amino acids by axenic cultures of Navicula salinarum and Amphiprora cf. paludosa was measured by High Performance Liquid Chromatography (HPLC). Ammonium ions at concentrations of 5 to 100 micromoles/liter (umol/l) effectively suppressed the utilization of concentrations of 100 umol/l of nitrate, but did not eliminate the uptake of amino acids in concentrations of 0.05 to 0.8 umol/l. N. salinarum assimilated low concentrations of several amino acids parallel with high concentrations of ammonium, whereas A. cf. paludosa depleted the concentration of aspartic and glutamic acid more rapidly than that of ammonium. Nitrogen-deprived cultures of both species assimilated spikes of amino acids very rapidly; half of the concentration added was assimilated in 0.5 hours. The assimilation of 6 D-amino acids was compared with that of the corresponding L- forms; the effect of the isomeric form on the uptake differed widely among the amino acids. The possible application of these uptake experiments to interstitial water is discussed. (Author's abstract)
W88-06860

COMMUNITY ELECTRON TRANSPORT OF PROCARYOTES IN EURYOXIC ESTUARINE SEDIMENT,
Connecticut Univ., Noank. Marine Research Lab.
E. A. Matson, and J. D. Buck.
Marine Ecology Progress Series MESEDT, Vol. 41, No. 1, p 71-78, November 25, 1987. 3 fig, 2 tab, 51 ref. Office of Water Resources Grant A-069-CONN.

Descriptors: *Microbiological studies, *Sediments, *Estuarine environment, *Mud, Euryoxic sediments, Anoxic sediments, New England, Oxygen, Tetrazolium, Electrochemistry, Metabolism, Interstitial water.

Rates of both tetrazolium and oxygen reduction were obtained seasonally from the top 8 cm of euryoxic estuarine sediment in southeastern New England, over an in situ temperature range of 0 to 20 degrees C. Anoxic tetrazolium reduction was highest in the 3 to 5 cm layers at 15 degrees C (up to 860 nmol 2e(-)/cu cm/hour). Changes in the chemistry of deeper pore-waters (20 to 60 cm)

occurring over 90 days indicated that metabolic rates (42 nmol 2e(-)/cu cm/hour) were about an order of magnitude lower than those in the surface sediments. Parallel simultaneous estimates of O2 reduction (reduced sediment preincubated in O2-saturated ambient waters plus or minus 10 mM NaN3) averaged 4 times greater than tetrazolium reduction. The postulated occurrence of a mixed metabolic community consisting of facultatively anaerobic heterotrophs and chemolithotrophs agrees with the field data. The community is spread out vertically through watery sediment of a quiescent, highly depositional cove. Soft-bodied infauna may help to maintain the Eh potential at ca -200 mV from 1 to 60 cm; the sediment is not sufficiently cohesive to be strongly poised. (Author's abstract)
W88-06861

TRACE METAL CONCENTRATIONS IN MUSSELS: COMPARISON BETWEEN ESTUARINE, COASTAL AND OFFSHORE REGIONS IN THE SOUTHEASTERN NORTH SEA FROM 1983 TO 1986,
Institut fur Hydrobiologie und Fischereiwissenschaft, Zeiseweg 9, D-2000 Hamburg 50, Federal Republic of Germany.
For primary bibliographic entry see Field 5A.
W88-06862

CARBON TRANSPORT BETWEEN A EUHALINE VEGETATED MARSH IN SOUTH CAROLINA AND THE ADJACENT TIDAL CREEK: CONTRIBUTIONS VIA TIDAL INUNDATION, RUNOFF AND SEEPAGE,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
T. G. Wolaver, and J. D. Spurrier.
Marine Ecology Progress Series MESEDT, Vol. 42, No. 1, p 53-62, January 4, 1988. 6 fig, 6 tab, 21 ref. NSF Grant DEB 8119752.

Descriptors: *Carbon transport, *Salt marshes, *Tidal rivers, *Organic carbon, *Estuarine environment, South Carolina, Tidewater, Tidal effects, Marshes, Runoff, Seepage, Estuarine environment.

Exchange of organic carbon (dissolved organic carbon (DOC) and particulate organic carbon (POC)) between a euhaline vegetated marsh and an adjacent tidal creek (North Inlet, South Carolina) was studied on 40 tidal cycles between 15 April 1983 and 19 June 1984. A flume was utilized to evaluate the role of the vegetated marsh in processing carbon during tidal inundation and a drainage weir was used to measure export from the marsh via runoff and seepage during low tide exposure (including storm events). Mean flood water DOC concentrations varied seasonally from 3.1 to 18.6 ppm. Maximum concentrations were observed in late winter and early spring, and were associated with freshwater discharge from the adjacent forest. There was a statistically insignificant (alpha = 0.05) DOC import to the vegetated marsh during tidal inundation of 2.9 g C/sq m/year. Mean flood water POC concentrations varied seasonally between 0.7 and 4.6 ppm with the highest values observed during the summer. The vegetated marsh was a sink for POC during tidal inundation except when storm events occurred on the ebb tide. There was a statistically significant (alpha = 0.05) import of POC to the vegetated marsh of 83.3 g C/sq m/year with the largest removal rate observed when the tidal water resided on the low marsh (tall Spartina alterniflora). Exports of DOC and POC from the marsh via runoff and seepage during low tide exposure (including rain events) were 36.2 gC/sq m/year and 30.6 g C/sq m/year. The annual net exchange (imports-exports) of carbon between the marsh and the adjacent tidal creek suggests this system is a sink for POC and a source for DOC, the total organic carbon exchange being negligible. The study implies that the vegetated marsh may not be the source of carbon which was found to outwell from this and other marsh-estuarine systems. (Author's abstract)
W88-06863

SWELL MODEL OF THE GERMAN BIGHT,
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W88-06864

FRESHWATER PULSE - A NUMERICAL MODEL WITH APPLICATION TO THE ST. LAWRENCE ESTUARY,
Physical and Chemical Sciences Branch, Department of Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, B2Y 4A2.
K.-T. Tee, and T.-H. Lim.
Journal of Marine Research JMMRAO, Vol. 45, No. 4, p 871-909, November 1987. 26 fig, 25 ref.

Descriptors: *Tides, *Streamflow, *Freshwater pulse, *Estuaries, *Model studies, *Mathematical models, *Estuarine circulation, *St. Lawrence Estuary, Water circulation, Mathematical equations, Mathematical studies, Coastal waters, Salinity minimum.

The freshwater pulse, characterized by a salinity minimum, has been observed in many coastal areas. A 2-D numerical model was developed to investigate the laterally averaged estuarine circulation, and the freshwater pulse in the St. Lawrence Estuary. The effects on the circulation and salinity of various parameters, including vertical eddy coefficients, river runoff, the bottom friction coefficient and the open boundary condition were studied. The freshwater pulse in the St. Lawrence Estuary was simulated using a seasonal variation of the freshwater runoff. In addition to simulating the downstream propagation and the reduction of the pulse's amplitude toward both the ocean and the deep water in most of the areas, several interesting results were produced. These include: (1) the finding of the maximum and minimum amplitudes of the pulse, (2) the increase of the amplitude from surface to deep water in the far upstream region, (3) the initial formation of the pulse at two surface locations, (4) the increase of the arrival time from surface to deep water, and (5) the increase of the arrival time for deep water pulses (at 25 m or deeper) toward the slope region where the upstream shallow water and the downstream deep water separates. The responses of the horizontal and vertical velocities to the freshwater pulse are described. Dynamics associated with the distribution, formation and propagation of the pulse are discussed. (Author's abstract)
W88-06867

RELATIVE MOBILITY OF RADIOACTIVE TRACE ELEMENTS ACROSS THE SEDIMENT-WATER INTERFACE IN THE MERL MODEL ECOSYSTEMS OF NARRAGANSETT BAY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W88-06868

TRACE ELEMENTS IN SURFACE SEDIMENTS OF NAVARINO BAY, GREECE,
Department of Geology, University of Patras, Patras, Greece.
For primary bibliographic entry see Field 5B.
W88-06881

TRANSPORT OF FINE-GRAINED SEDIMENTS IN SHALLOW WATERS,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W88-06890

RESPONSES OF ESTUARINE MACROFAUNA COLONIZING SEDIMENTS CONTAMINATED WITH FENVALERATE,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W88-06923

WETLAND DEVELOPMENT TRENDS IN COASTAL NORTH CAROLINA, USA, FROM 1970 TO 1984,
Duke Univ., Durham, NC. School of Forestry.
For primary bibliographic entry see Field 6G.
W88-06973

EFFECT OF 5-FLUORO-2'-DEOXYURIDINE ON (3H)THYMIDINE INCORPORATION BY BACTERIOPLANKTON IN THE WATERS OF SOUTHWEST FLORIDA,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W88-07006

EFFECT OF 5-FLUORO-2'-DEOXYURIDINE ON (3H)THYMIDINE INCORPORATION BY BACTERIOPLANKTON IN THE WATERS OF SOUTHWEST FLORIDA,
University of South Florida, St. Petersburg. Dept. of Marine Science.
W. H. Jeffrey, and J. H. Paul.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 331-336, February 1988. 8 fig, 1 tab, 27 ref. DOC Grant NA86AA-D-SG068 and NSF Grant BSR 8605170.

Descriptors: *Nucleic acids, *Microbiological studies, *Deoxyuridine, *Bacterioplankton, *Limnology, *Florida, *Isotope studies, *Radioactive tracers, Thymidine, Microorganisms, Enzymes, Aquatic habitats, Primary productivity, Bacteria.

The effect of 5-fluoro-2'-deoxyuridine (FdUrd) on (methyl-3H)thymidine incorporation by bacterioplankton populations in subtropical freshwater, estuarine, and oceanic environments was examined. In estuarine waters, intracellular isotope dilution was inhibited by FdUrd, which permitted the estimation of both intracellular and extracellular isotope dilution. In 2 of 10 cases, extracellular isotope dilution was significant. At low concentrations of (methyl-3H)thymidine or (6-3H)thymidine, FdUrd completely inhibited incorporation of radioactivity into protein and RNA. At high concentrations of (3H)thymidine, however, FdUrd had little effect on labeling patterns. The dihydrofolate reductase inhibitors amethopterin and trimethoprim had no effect on macromolecular labeling patterns. These results suggest that thymidylate synthase is not involved in nonspecific labeling and that FdUrd inhibits nonspecific labeling by blocking some other enzyme involved in thymidine catabolism. In oligotrophic oceanic and freshwater samples, FdUrd did not inhibit intracellular isotope dilution or (3H)thymidine labeling of protein and RNA, but caused some inhibition of (3H)thymidine incorporation into DNA. The ability of FdUrd to inhibit nonspecific macromolecular labeling during (3H)thymidine incorporation was significantly correlated (r=0.84) with total thymidine incorporation (in picomoles/liter/hr). The results are discussed in terms of applications of FdUrd to routine bacterial production measurements and the general assumptions of (3H)thymidine incorporation. (Author's abstract)
W88-07006

SEASONAL AND DIEL VARIABILITY IN DISSOLVED DNA AND IN MICROBIAL BIOMASS AND ACTIVITY IN A SUBTROPICAL ESTUARY,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2H.
W88-07021

MICROBIAL DECOMPOSITION IN AQUATIC ENVIRONMENTS: COMBINED PROCESS OF EXTRACELLULAR ENZYME ACTIVITY AND SUBSTRATE UPTAKE,
Institut fur Meereskunde, Dusternbrooker Weg 20, D-2300 Kiel, Federal Republic of Germany.
For primary bibliographic entry see Field 5B.
W88-07023

DUAL-LABEL RADIOISOTOPE METHOD FOR SIMULTANEOUSLY MEASURING BACTERIAL PRODUCTION AND METABOLISM IN NATURAL WATERS,
George Mason Univ., Fairfax, VA. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W88-07024

MAGNITUDE-FREQUENCY RELATIONSHIP OF COASTAL SAND DELIVERY BY A SOUTHERN CALIFORNIA STREAM,
San Diego State Univ., CA.
For primary bibliographic entry see Field 2J.
W88-07053

ECOLOGICAL CONSEQUENCES OF MECHANICAL HARVESTING OF CLAMS,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
For primary bibliographic entry see Field 4C.
W88-07063

ECOLOGICAL EFFECTS OF COASTAL MARSH IMPOUNDMENTS: A REVIEW,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 6G.
W88-07100

BACKFILLING CANALS TO MITIGATE WETLAND DREDGING IN LOUISIANA COASTAL MARSHES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 4A.
W88-07104

TRIBUTYLTIN (TBT) IN THE WATERS OF A SCOTTISH SEA LOCH ARISING FROM THE USE OF ANTIFOULANT TREATED NETTING BY SALMON FARMS,
DAFS Marine Laboratory, P.O. Box 101, Victoria Road, Aberdeen AB9 8DB (Great Britain).
For primary bibliographic entry see Field 5B.
W88-07117

OCCURRENCE AND DIET OF FISHES IN A TIDAL INLET TO A SALTMARSH IN SOUTHERN MORETON BAY, QUEENSLAND,
Fisheries Management Branch, Department of Primary Industries, Brisbane, Qld 4000, Australia.
For primary bibliographic entry see Field 8I.
W88-07167

SALT TOLERANCE IN THE HALOPHYTE SUAEDA MARITIMA L. DUM. GROWTH, ION EXCHANGE IN RESPONSE TO ALTERED SALINITY,
Sussex Univ., Brighton (England). School of Biological Sciences.
N. J. W. Clipson.
Journal of Experimental Botany, Vol. 38, No. 197, p 1996-2004, December 1987. 4 fig, 22 ref.

Descriptors: *Halophytes, *Salt tolerance, *Photosynthesis, *Tissue analysis, *Elastic properties, *Plant physiology, *Salinity, *Salt marsh, Chloride, Potassium, Sodium, Ions, Chemical properties, Pressure-volume curve, Mathematical analysis, Metabolism, Osmotic pressure, Osmotic potential, Saline water.

Shoot and root fresh and dry weights and shoot sodium, chloride and potassium contents were measured and shoot relative growth rates calculated in seedlings of Suaeda maritima over a period of 11 d following a raising of culture solution salinity from 0 to 200 mol/cu m NaCl. Growth rates and sodium and chloride contents, as compared to plants growing in the absence of salt were increased while potassium contents declined. Shoot sodium accumulation rate and the rate of transport of sodium from root to shoot, osmotic potential, and rates of photosynthesis and transpiration were also measured for up to 72 h after transfer of plants originally growing at 0 and 200 mol/cu m NaCl to 200 and 400 mol/cu m NaCl, respectively. Ion uptake and transport rates were maximal 6-12 h after transfer and then declined to new steady-state levels within 48 h; osmotic potentials were lowered over a 72 h period on average by approximately 1.0 MPa; and after 9 h photosynthetic and transpiration rates were reduced by about 20% and 30%, respectively. Results are discussed in terms of the ability of halophytes to adjust to fluctuating salinity and to salt tolerance mechanisms in general. (Author's abstract)
W88-07212

IONIC AND WATER RELATIONS RESPONSES OF TWO POPULATIONS OF A NON-HALOPHYTE TO SALINITY,
Duke Univ., Durham, NC. Dept. of Botany.
W. D. Bowman.
Journal of Experimental Botany, Vol. 39, No. 198, p 97-105, January 1988. 3 fig, 2 tab, 40 ref, NSF Grant BSR 861-2381.

Descriptors: *Halophytes, *Salth marshes, *Plant growth, *Plant physiology, *Photosynthesis, *Salt tolerance, *Saline water, Grasses, Salinity, Chemical properties, Transpiration, Osmotic pressure, Salt balance, Ions, Sodium, Chloride, Potassium, Proline.

Salinity-induced changes in the ionic and water relations in plants from two naturally-occurring populations of the C4 non-halophyte Andropogon glomeratus were measured to detect differences in the capacity to adjust osmotic potentials and in ion content potentially responsible for the osmotic adjustment. Pressure-volume curves and leaf ion content were measured in plants from two populations, salt marsh and inland, after long-term exposure to three salinity levels. Osmotic adjustment and decreases in the bulk tissue elasticity occurred to a similar extent in both populations with increasing salinity. Cl(+) concentrations increased with increasing salinity in both populations, whereas leaf Na(+) concentrations increased only in the inland population, but were higher at all salinities in the marsh population. K(+) concentrations changed little with increasing salinity. Proline concentrations increased only at the highest salinity level, and did not differ significantly between populations. These results suggest a role for Na(+) uptake and regulation in cosmotic adjustment in the marsh population, contrasting with studies of salt tolerance in other non-halophytic grasses. (Author's abstract)
W88-07216

NUMERICAL MODELING OF SOLUTE TRANSPORT PATTERNS IN THE DAMMAM AQUIFER,
Civil Engineering Department, King Fahd University of Petroleum and Minerals, Dhaharan, Saudi Arabia.
For primary bibliographic entry see Field 5B.
W88-07280

NUMERICAL MODELING OF SEPARATION EDDIES IN SHALLOW WATER,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-07451

PHYTOPLANKTON POPULATION DYNAMICS AND THE FATE OF PRODUCTION DURING THE SPRING BLOOM IN AUKE BAY, ALASKA,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, P. K. Bienfang, D. A. Ziemann, and L. D. Conquest.
Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 57-65, January 1988. 4 fig, 1 tab, 42 ref. DOC Contract NA-85-ABH-00022 and NSF Grant OCE 85-13594.

Descriptors: *Limnology, *Population dynamics, *Phytoplankton, *Auke Bay, *Coastal waters, *Limiting nutrients, *Primary productivity, Eutrophication, Model studies, Zooplankton, Biomass, Nutrients, Irradiance, Temperature, Growth rates, Chlorophyll a.

Primary production rates and the concentrations and vertical fluxes of phytoplankton pigments were measured in Auke Bay, Alaska, on a twice-weekly basis over a period of 56 d spanning the 1985 spring bloom. Application of a slightly modified version of the Welschmeyer-Lorenzen equations yielded growth rates that were in excellent agreement with the ratio of primary production to particulate carbon in the water column. These results suggest that the assumption in the Welschmeyer-Lorenzen model that chlorophyll a is converted to pheopigments with an efficiency of about 66% as a result of zooplankton grazing is probably close to the truth in this system. Of the primary production that occurred during the study period, about 40% was lost from the euphotic zone due to the sinking of viable cells and 58% was lost due to zooplankton grazing. Only about 1.5% of the primary production remained in the euphotic zone in the form of additional phytoplankton biomass at the end of the study. Herbivorous zooplankton were estimated to be assimilating at least 58% of the phytoplankton carbon they ingested - a conclusion in reasonable agreement with previously published laboratory studies. Although phytoplankton biomass in this system appears to be limited by the supply of nitrate, phytoplankton growth rates seem to be limited by either irradiance or temperature. (Author's abstract)
W88-07467

THERMODYNAMIC SOLUBILITY RELATIONSHIPS OF INORGANIC VANADIUM IN THE MARINE ENVIRONMENT,
Water Resources and Environment Div., Research Inst., King Fahd Univ. of Petroleum and Minerals, Dhahran 31261 (Saudi Arabia).
For primary bibliographic entry see Field 5B.
W88-07485

ORIGINS OF SEAWATER INTRUSION IN A COASTAL AQUIFER - A CASE STUDY OF THE PAJARO VALLEY, CALIFORNIA (USA),
Geological Survey, Menlo Park, CA.
L. D. Bond, and J. D. Bredehoeft.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 363-388, July 15, 1987. 18 fig, 6 tab, 20 ref.

Descriptors: *Saline water intrusion, *Coastal aquifer, *Groundwater pollution, *Seawater, *Groundwater movement, Aquifers, Brackish water, Recharge.

Seawater may enter and contaminate stratified coastal aquifers through a number of different pathways. These pathways and their relative contribution were examined in the Pajaro Valley, California (USA), a coastal area with extensive groundwater. This study considers three pathways of possible intrusion of the primary confined aquifer: (1) onshore leakage from brackish sources, the estuary and sloughs, through the confining layer; (2) near-shore leakage from the ocean through the confining layer; and (3) offshore flow from the ocean from the submarine canyon outcrop of the aquifer. Groundwater flow and seawater intrusion are simulated using an areal, two-dimensional solute-transport computer model. This analysis indicates that leakage flow through confining layers is the principal method of recharge to the aquifer. Although lateral flow through the offshore outcrop contaminates the aquifer, as a whole, at a higher rate, vertical leakage through the sea floor initially in the main pathway of seawater intrusion to the onshore portion of the aquifer. It is likely that leakage generally is the dominant method of recharge and initial cause of seawater intrusion for poorly confined, stratified coastal aquifers. This analysis suggests that a significant time interval follows the initial observation of seawater intrusion, during which remedial action can be taken to control lateral flow through the offshore outcrop, which ultimately will be the largest component of future intrusion in these aquifers. (Author's abstract)
W88-07521

GEOCHEMICAL CALCULATIONS AND OBSERVATIONS ON SALT WATER INTRUSIONS, I.A. COMBINED GEOCHEMICAL/MIXING CELL MODEL,
Institute for Earth Sciences, Vrije Universiteit, De Boelelaan 1085, 1081 HV Amsterdam (The Netherlands).
C. A. J. Appelo, and A. Willemsen.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 313-330, October 30, 1987. 10 fig, 5 tab, 34 ref.

Descriptors: *Groundwater movement, *Flow, *Computer models, *Saline water intrusion, *Saline-freshwater interfaces, *Geochemistry, *Groundwater, *Model studies, Computer programs, Polders, Floods, Paleohydrology.

A combined geochemical/mixing cell flow model has been developed. The geochemical model, based on the computer program eq3/6, has been modified to include cation exchange reactions and is incorporated in a one-dimensional mixing cell model for stationary one-dimensional transport. Dispersion or diffusion is calculated by mixing the cell contents with neighboring cells. Relationships between mixing factors and dispersivity and diffusion coefficients were derived. The model was used to simulate concentration changes during salt water intrusions. Fundamental differences are shown to exist between diffusion of salt water from a stagnant water body and dispersive intrusions during marine transgressions or flooding events. With dispersive flow, characteristic water compositions develop in space and time as a result of cation exchange. With diffusion, these steep concentration gradients are smoothed out and mixed compositions occur. The concept that characteristic concentrations occur during dispersive flow was used to obtain paleohydrological information in a Dutch polder. The depth of the fresh/salt water interface before polder development is deduced from a simulation of observed exchange reactions in the polder groundwater. (Author's abstract)
W88-07583

INTERSPECIFIC DIFFERENCES IN DEAD PLANT BUFFERING CAPACITY ALTER THE IMPACT OF ACID RAIN ON DECOMPOSITION RATES IN TIDAL MARSHES,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 5B.
W88-07595

INFLUENCE OF THE TIDE ON RAINFALL IN A TIDAL AREA,
Institute of Earth Sciences, Amsterdam.
For primary bibliographic entry see Field 2B.
W88-07646

LOCAL CHANGES OF SALINITY AND NUTRIENTS AND PROCESSES CONTRIBUTING TO THE NUTRIENT DISTRIBUTION OFF THE EVROS RIVER, IN THE NORTH AEGEAN SEA,
Institute of Oceanographic and Fisheries Research, GR-166 04, Hellinikon, Greece.
N. Friligos.
Toxicological and Environmental Chemistry TXECBP, Vol. 16, No. 1, p 1-16, 1987. 5 fig, 4 tab, 36 ref.

Descriptors: *Nutrients, *Saline water, *River mouth, *Nitrogen compounds, Plumes, Salinity, Nutrient distribution, Evros River, Silicates, Ammonia, Nitrites, Nitrates, Phosphates, Spatial distribution, Temporal distribution, Limiting nutrients, Greece, Aegean Sea, Limiting nutrients.

The distribution of salinity, silicate, ammonia, nitrite, nitrate, and phosphate off the Alexandroupolis coast, both inside and outside the Evros River plume, was observed during three cruises between March 1981 and March 1982. The most important river source of nutrients is the Evros River and the data show that there is a large spatial and temporal variability of salinity and nutrients during both high and low discharge periods. The extension of the area influenced by the river mouth is characterized by a highly significant correlation between salinity and nutrients. This indicates a control of the dynamics of the nutrients by the physical processes of dilution. In the second zone, lying further from the river mouth, this correlation is lost because of the superposition of biological factors. The fact that in some zones the concentration of the total inorganic nitrogen was sometimes found to be undetectable suggests that nitrogen could be the growth limiting factor. (Author's abstract)
W88-07695

ENVIRONMENTAL CONTAMINANTS IN BIRDS: PHOSPHATE-MINE AND NATURAL WETLANDS,
Florida Univ., Gainesville. Dept. of Wildlife and Range Sciences.
For primary bibliographic entry see Field 5B.
W88-07754

EFFECTS OF RAINFALL ON THE SEASONAL THERMOCLINE,
Naval Postgraduate School, Monterey, CA.
For primary bibliographic entry see Field 2B.
W88-07778

EARLY DIAGENESIS OF AMINO ACIDS AND ORGANIC MATTER IN TWO COASTAL MARINE SEDIMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. M. Henrichs, and J. W. Farrington.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 1, p 1-15, January 1987. 4 fig, 5 tabs, 57 ref, append.

Descriptors: *Diagenesis, *Sediment diagenesis, *Benthic fauna, *Bioturbation, *Estuarine sediments, *Amino acids, *Organic matter, *Bacteria, Marine sediments, Sedimentation, Decomposition, Nitrogen compounds, Organic carbon, Carbon dioxide, Sulfides, Comparison studies, Fauna, Massachusetts, Rhode Island.

Surface sediments of Buzzards Bay, Massachusetts (BBP) are oxic to suboxic and are extensively bioturbated by deposit-feeding infauna, while sediments of the Pettaquamscutt River Estuary, Rhode Island (PRE) are reducing and overlain by anoxic bottom water. Sediments from these two sites were analyzed for total organic carbon and nitrogen, total hydrolyzable amino acids, dissolved free amino acids, and porewater dissolved organic carbon, ammonium, total carbon dioxide, and sulfide, to describe and compare the early diagenesis. Based on model calculations, organic matter remineralization rates in the upper meter of BBP and PRE sediments are of similar magnitude, at 14 and 10 g C/sq m x year, respectively. The surface sediment organic carbon accumulation rates at the two sites are also similar, 36 (BBP) and 30 (PRE) g C/ sq m x year. Thus, the unusually high organic content of PRE Sediments (>12% by weight organic carbon) does not result from much greater deposition rates or from much lower decomposition rates than in BBP sediments, Which contain only 2% organic carbon. Total hydrolyzable amino acids made up 11 to 23% of the total carbon remineralized in BBP sediments. Decomposition did not result in detectable changes in hydrolyzable amino acid composition at either site. Glutamic acid and beta-aminoglutaric acid were major constituents of the sediment dissolved free amino acids. Dissolved free amino acid distributions in these sediments are probably the net result of production and consumption by bacteria. Macrofauna and adsorption to sediments are additional sinks for dissolved amino acids in Buzzards Bay sediments, but they do not appear to be responsible for the major features of the dissolved free amino acid distributions. (Author's abstract)
W88-07918

CELESTITE (SRSO4(S)) SOLUBILITY IN WATER, SEAWATER AND NACL SOLUTION,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2K.
W88-07921

SEASONAL DISTRIBUTIONS AND TURNOVER OF REDUCED TRACE GASES AND HYDROXYLAMINE IN YAQUINA BAY, OREGON,
Oregon State Univ., Corvallis. Coll. of Oceanography.
J. H. Butler, R. D. Jones, J. H. Garber, and L. I. Gordon.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 3, p 697-706, March, 1987. 5 fig, 6 tab, 68 ref.

Descriptors: *Atmosphere, *Chemical properties, *Estuaries, *Seasonal distribution, *Turnover time, *Trace gases, Yaguina Bay, Oregon, Microorganisms, Upwelling, Seawater, Runoff, Sediment distribution, Hydroxylamine, Nitrous oxide, Carbon dioxide, Methane, Ammonium, Hydrogen.

The distributions of methane, carbon monoxide, nitrous oxide, and hydrogen along the length of the Yaquina River estuary were examined on 6 occasions over a year's time during 1983 and 1984. To help evaluate the fluxes of these reduced trace gases, hydroxylamine concentrations and microbial oxidation rates for methane, carbon dioxide, and ammonium were measured along with the trace gases. Methane, introduced primarily from a wastewater discharge, attained high levels of supersaturation, and was removed almost entirely by atmospheric evasion. Carbon monoxide was produced and consumed rapidly by microbes in the estuary, atmospheric evasion contributing little to its overall cycling. Nitrous oxide apparently entered the estuary from fall runoff, upwelled seawater, and sedimentary diffusion, with little relative contribution from aquatic nitrification. Hydroxylamine concentrations correlated positively with ammonium oxidation rates, but whether these processes were one and the same is unknown. Hydrogen production rates apparently were high, as H2 remained supersaturated at all times in the estuary. (Author's abstract)
W88-07926

FACTORS AFFECTING PORE WATER HYDROCARBON CONCENTRATIONS IN PUGET SOUND SEDIMENTS,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W88-07927

CONTINENTAL WEATHERING OF GERMANIUM: GE/SI IN THE GLOBAL RIVER DISCHARGE,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2K.
W88-07931

ORIGIN OF SALT IN COASTAL MARSHES OF HUDSON AND JAMES BAYS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
J. S. Price, and M. K. Woo.
Canadian Journal of Earth Sciences CJESAP, Vol. 25, No. 1, p 145-147, January 1988. 2 fig, 12 ref.

Descriptors: *Marshes, *Coastal marshes, *Salinity, *Sediment distribution, *Isostatic uplift, *Diffusion, Chemical properties, Permeability, Hudson Bay, James Bay, Tyrell Sea, Oxygen isotopes, Isotope studies.

The presence of salt in isostatically uplifted coastal marshes well removed from tidal sources suggests that the salt is relict in origin. This was confirmed by the measured downward increase in salinity towards the deeper and older Tyrell Sea sediments and by the presence of water isotopically heavier than the present-day meteoric or tidal waters. The low permeability of marsh sediments and the vertical distribution of salt indicate that diffusion is transmitting salt toward the surface, where it is subsequently removed by surface flow. Salt concentration decreases with distance inland, where the salt-loss processes have proceeded for a longer time. The chloride concentration of the deep pore water suggests that the total salinity of the postglacial Tyrell Sea was 21-25 g/l. (Author's abstract)

W88-07940

IDENTIFICATION OF THE POSITION AND THE STEREOCHEMISTRY OF THE DOUBLE BOND IN MONOUNSATURATED FATTY ACID METHYL ESTERS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY OF DIMETHYL DISULFIDE DERIVATIVES,
Laboratoire de Physique at Chimie Mariens, Universite Pierre et Marie Curie, UA CNRS No. 353, tour 24, 4 Place Jussieu, 75252 Paris Cedex 05, France.
For primary bibliographic entry see Field 7B.
W88-07950

DUPUIT-GHYBEN-HERZBERG ANALYSIS OF STRIP-ISLAND LENSES,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-07953

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SELECTION OF MEMBRANES FOR TREATMENT OF BLEACHING EFFLUENTS,
Alfa-Laval Separation AB, Filtration Technology, P.O. Box 500, S-147 00 Tumba, Sweden.
For primary bibliographic entry see Field 5D.
W88-07217

APPLICATION OF MEMBRANES IN ENVIRONMENTAL PROTECTION,
Institute of Environmental Chemistry, Chinese Academy of Science, P.O. Box 934, Beijing, China.
For primary bibliographic entry see Field 5D.
W88-07218

DEVELOPMENT OF POLYSULFONAMIDE MEMBRANE AND ITS APPLICATION IN TREATING CHROMIUM PLATING WASTEWATER,
The Beijing Municipal Research Institute of Environmental Protection, Fu Wai Avenue, Beijing, China.
For primary bibliographic entry see Field 5D.
W88-07219

INFLUENCE OF DIFFERENT TYPES OF METAL COMPLEX ON THE TRANSITIVITY OF REVERSE OSMOSIS MEMBRANES,
Department of Chemical Engineering and Environmental Engineering, Laboratory for Environmental Protection Research, Beijing Polytechnic University, Beijing, China.
For primary bibliographic entry see Field 5D.
W88-07220

SIGNIFICANCE OF COLOUR CHANGES IN SOME REVERSE OSMOSIS PERMEATORS,
For primary bibliographic entry see Field 5D.
W88-07221

INVESTIGATION OF THE MODIFIED FOULING INDEX AS A TEST FOR PLUGGING POTENTIAL OF PRETREATED SEAWATER,
North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
D. R. Van Der Vaart, and E. P. Stahel.
Desalination DSLNAH, Vol. 68, No. 1, p 45-56, January 1988. 7 fig, 1 tab, 16 ref.

Descriptors: *Membrane processes, *Water treatment, *Pretreatment of water, *Reverse osmosis, *Fouling, *Seawater, *Desalination, *Effluents, *Mathematical analysis, Plugging potential, Fouling index.

The pretreatment of raw seawater is necessary to reduce the fouling of reverse osmosis membranes and increase run length. To measure the plugging potential of pretreated feedwater, the modified fouling index was tested using both control suspensions and pretreated seawater. The defining equation was found to adequately describe the process. By distinguishing between the various filtration mechanisms, the modified fouling was found to be more precise than other plugging indexes. A scheme is presented for the in situ, computer-controlled measurement of the modified fouling index. (Author's abstract)
W88-07222

DESALINATION OF AGRICULTURAL DRAINAGE RETURN WATER: I. OPERATIONAL EXPERIENCES WITH CONVENTIONAL AND NONCONVENTIONAL PRETREATMENT METHODS,
Brown and Caldwell, Pleasant Hill, CA.
For primary bibliographic entry see Field 5D.
W88-07229

DESALINATION OF AGRICULTURAL DRAINAGE RETURN WATER: II. ANALYSIS OF THE PERFORMANCE OF A 13,000 GDP RO UNIT,
California Univ., Berkeley. Dept. of Sanitary and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-07230

MEMBRANE DEVELOPMENT FOR SEAWATER DESALINATION,
Chemical Engineering Department, University of Naples, Italy.
E. Brioli.
Desalination DSLNAH, Vol. 63, p 57-69, June 1987. 2 fig, 4 tab, 5 ref.

Descriptors: *Desalination, *Membrane processes, *Reverse osmosis, *Seawater, Membranes, Polymers, Ultrafiltration, Membrane distillation, Pretreatment of water, Salt rejection, Chemical properties, Thermal properties, Capital costs, Operating costs, Technology, Optimization, Filtration.

Reverse osmosis is today an attractive and competitive basic unit operation for small and large scale seawater desalination. This paper discusses the available reverse osmosis membranes of interest in sea water desalination and possible future developments in the field. Various membranes and modules are already available whose performance and affordability are of interest. New polymeric composite asymmetric membranes with high or moderate rejection of salts are under test in various countries and will become commercially available. Their higher chemical and thermal resistance might simplify operating procedures, increase reverse osmosis flexibility, and decrease capital and operating costs. The possibility of integrating reverse osmosis with other membrane separation techniques in seawater desalination is also of interest. Cross-flow microfiltration or ultrafiltration, particularly in the pretreatment phase, and membrane distillation are two processes which, combined with reverse osmosis, can contribute to the optimization of seawater desalination. (Author's abstract)
W88-07231

PRETREATMENT SYSTEM IN REVERSE OSMOSIS PLANTS,
Jeddah Plants, Western Region, P. O. Box 7624, Jeddah 21221, Saudi Arabia.
T. K. Osta, and L. M. Bakheet.
Desalination DSLNAH, Vol. 63, p 71-80, June 1987. 4 tab.

Descriptors: *Desalination, *Membrane processes, *Reverse osmosis, *Pretreatment of water, *Water treatment facilities, *Performance evaluation, *Clogging, *Fouling, Scaling, Microorganisms, Algal growth, Slime, Suspended solids, Colloids, Oxides, Oil pollution, Grease, Sterilization, Biocides, Sodium bisulfite, Chlorine, Copper sulfate, Feedwater treatment, Specifications, Saudi Arabia.

The water fed to the membrane affects the successful operation of Reverse Osmosis (RO) plants. In order for economical membrane life to be achieved, the feedwater must satisfy the membrane manufacturer's requirements. Scale, biological slime, suspended solids, colloids, metal oxides, and oil and grease are feedwater impurities which can foul the membrane, decreasing its productivity or even causing membrane blockage or damage. This paper discusses experience with, and performance of, pretreatment systems in RO plants at Al-Birk and Umm Lujj in Saudi Arabia. The Al-Birk plant operated satisfactorily during its performance and reliability test. Since that time, however, performance has steadily declined; microorganism fouling is the main problem. Membrane sterilization with sodium bisulfite has improved performance, but neither design performance nor manufacturers' guaranteed performance has been met. Microorganism fouling is also a problem at the Umm Lujj plant. The problem was initially treated with chlorine, but this biocide is damaging to the membrane itself. Copper sulfate was found to be effective, but only on algal growth. In the event of filter plugging, shock dosing with chlorine is resorted to as a backup procedure. (Shidler-PTT)
W88-07232

PRE- AND POST-TREATMENT AT THE RO PLANT AT RA'S ABU JARJUR, BAHRAIN,
Ministry of Works and Power, Electricity Directorate, State of Bahrain.
M. al-Arrayedhy.
Desalination DSLNAH, Vol. 63, p 81-94, June 1987. 2 fig, 5 tab.

Descriptors: *Desalination, *Reverse osmosis, *Pretreatment of water, *Posttreatment of water, Performance evaluation, Bahrain, Groundwater, Saline water, Hydrogen sulfide, Hydrocarbons, Membranes, Filters, Algal growth, Bacteria, Sterilization, Potable water, Corrosion control, Water quality.

A reverse osmosis (RO) plant, with a capacity of 46,000 cu m per day (10 MIGD), was started up at Ra's Abu Jarjur, Bahrain, in October 1984. The raw water source is high-salinity groundwater, containing dissolved hydrogen sulfide and miscible hydrocarbons. The plant is at present the largest in the world with seawater membranes. Results of the first year of operation are outlined in this paper with special emphasis on water pretreatment and posttreatment. Some problems with algae and excessive bacterial growth in the pretreatment filters have been met and effectively controlled. Further investigations to improve sterilization methods are in progress. The posttreatment plant, designed to produce a good quality potable water with good corrosion characteristics, has also been shown to be successful. The water quality is better than originally predicted. (Shidler-PTT)
W88-07233

PRETREATMENT OF SURFACE SEAWATER FEED AT DROP,
Petroleum, Petrochemicals, and Materials Division, Kuwait Institute for Scientific Research, P. O. Box 24885, 13109 Safat, Kuwait.
S Ebrahim, and A. Malik.
Desalination DSLNAH, Vol. 63, p 95-107, June 1987. 10 fig, 4 ref.

Descriptors: *Pretreatment of water, *Seawater, *Water treatment facilities, *Desalination, *Reverse osmosis, *Feedwater treatment, Membranes, Fouling, Particulate matter, Colloids, Silt, Turbidity, Hydrogen ion concentration, Temperature, Chlorine, Flocculation, Coagulation, Filtration, Filter media, Water quality, Doha Reverse Osmosis Plant, Design criteria, Kuwait.

Proper pretreatment to eliminate or minimize the fouling potential of feedwater is one of the main factors in the successful long-term operation of reverse-osmosis (RO) water desalination systems, regardless of the type of membrane used. At the Doha Reverse Osmosis Plant (DROP) in Kuwait, flocculation and dual media filtration is used to treat surface seawater feed. The pretreatment

system is designed to provide the three different membrane configuration systems with water of suitable quality and required quantity. The quality is monitored by measuring the silt density index (SDI), turbidity, pH, temperature, and chlorine content. This paper describes the pretreatment involved, problems encountered, and the feedwater quality after treatment during the two years of operation. The common pretreatment of DROP has been successfully controlled (most of the time) to give an SDI of less than 4.0, which is acceptable by RO lines I and III. The common pretreatment system uses the basic principle of removing suspended and colloidal particles from the untreated water by coagulation-flocculation followed by gravity filtration. With the aid of an in-line coagulation system, the SDI of less than 3.0 required for RO line II has also been maintained. In general, the individual pretreatment systems of all RO lines have been managed to give satisfactory feedwater quality in accordance with the membrane manufacturer's requirements. This achievement resulted in reducing membrane-cleaning frequencies, maintaining design recoveries, and increasing RO availability. (Shidler-PTT)
W88-07234

EVALUATION OF THE THREE POST-TREATMENT SYSTEMS AT DOHA SEAWATER REVERSE OSMOSIS PLANT--KUWAIT,
Water Resources Development Centre, Ministry of Electricity and Water, P. O. Box 12020, 71651 Safat, Kuwait.
F. al-Awadi, and M. Abdel-Jawad.
Desalination DSLNAH, Vol. 63, p 109-117, June 1987. 3 fig, 7 tab, 5 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Reverse osmosis, Evaluation, Kuwait, Potable water, Membranes, Chemical treatment, Neutralization, Hydrogen ion concentration, Sodium chloride, Dissolved solids, Carbon dioxide, Chlorides, Sulfates, Alkalinity, Calcium carbonate, Limestone, Calcium Hydroxide, Lime, Decarbonators, Sodium hydroxide, Bicarbonates, Doha Reverse Osmosis Plant.

Doha Reverse Osmosis Plant was built to produce drinking water. The plant consists of three different reverse-osmosis (RO) membrane configuration systems, each of which has its own posttreatment process. The permeate from the three RO lines is characterized by low pH and high sodium chloride content. The permeate from RO line 1 is stabilized by passing it over a calcium carbonate (limestone) open bed. Total dissolved solids (TDS) are increased from 215 in the permeate to about 264 mg/l in the final product and the pH is raised to 6; carbon dioxide is reduced from 32 mg/l to 11 mg/l; and the chloride-sulfate/alkalinity ratio in the final product is about 6.8. The permeate from RO line 2 is stabilized by dosing it with a solution of calcium hydroxide (lime). The TDS level is increased from 240 mg/l in the permeate to 289 mg/l in the final product and the pH is raised from 6.2 to 7.9; carbon dioxide is reduced from 12 mg/l to 5 mg/l; and the chloride-sulfate/alkalinity ratio is 6.6. The permeate from RO line 3 is stabilized by decreasing the carbon dioxide concentration using a decarbonator; the remaining carbon dioxide in the water is neutralized by the addition of sodium hydroxide (caustic soda) to produce bicarbonate. The TDS level does not exhibit an appreciable increase since the alkalinity was slightly increased from 6 mg/l to 9 mg/l; the carbon dioxide content is reduced through the decarbonator and the addition of caustic soda from 31 mg/l in the permeate to 2 mg/l in the final product; and the final chloride-sulfate/alkalinity ratio is 46. (Shidler-PTT)
W88-07235

DESIGN OF REVERSE OSMOSIS PROCESS,
Department of Material Science and Chemical Engineering, Yokohama National University, Yokohama, Japan.
H. Ohya, K. Yajima, and R. Miyashita.
Desalination DSLNAH, Vol. 63, p 119-133, June 1987. 14 fig, 3 tab, 13 ref.

Descriptors: *Water treatment, *Reverse osmosis, *Design criteria, *Model studies, Membrane processes, Hydraulic permeability, Solute transport, Compaction, Plasticity, Mass transfer, Chemical properties, Physical properties, Caprolactan, Concentration, Seawater, Desalination, Japan.

A generalized approach to reverse osmosis (RO) process design is presented for solution-membrane systems characterized by the following membrane parameters: hydraulic permeability, solute permeability, reflection coefficient, solute-induced compaction coefficient, plasticizing coefficient of solute permeability, mass-transfer coefficient on the high-pressure side of the membrane, and the properties of the solutions. Examples of RO process design are carried out for epsilon-caprolactan concentration and seawater desalination using PEC-1000 spiral-wound modules and compared with experimental data reported by Toray Company, Ltd., for epsilon-caprolactan recovery from its nylon plant at Nagoya and by the 800 cu m/day RO seawater desalination plant at Chigasaki Beach by Water Reuse Promotion Center Japan. In both cases, the agreement between observed and calculated data is satisfactory. (Author's abstract)
W88-07236

ECONOMIC FEASIBILITY OF THE REVERSE OSMOSIS PROCESS FOR SEAWATER DESALINATION,
Leitner and Associates, Inc., 815 Shadow Lawn Drive, Elm Grove, WI 53122.
G. F. Leitner.
Desalination DSLNAH, Vol. 63, p 135-142, June 1987. 4 tab, 4 ref.

Descriptors: *Water treatment, *Desalination, *Reverse osmosis, *Economic feasibility, *Seawater, *Cost analysis, Financing, Capital costs, Design criteria, Wages, Operating costs, Multistage flash distillation, Energy, Membranes, Middle East.

Most important in any economic analysis of a desalting process is a comparative frame of reference. One of the most generally accepted cost references for desalination plants is that published by Oak Ridge National Laboratory, was updated last in 1981. To provide meaningful current seawater desalting cost data for the Middle East, this paper updates the 1981 study as it relates to reverse osmosis (RO), and introduces plant physical and cost data common to that geographic area. Ten bases for cost estimates were used: financial parameters, capital costs, indirect capital costs, plant load factor, plant design, chemical costs, energy costs, labor costs, membrane replacement, and other operating costs. The cost of desalted seawater by RO appears to be lower than for multistage flash (MSF) distillation. Further, RO is competitive for large dual-purpose plants, will favor RO. If experience indicates longer membrane life than used in this study (and there is evidence this may be the case) the RO cost advantage will be further strengthened. (Author's abstract)
W88-07237

CRITICAL COMPARISON BETWEEN ENERGY CONSUMPTION IN LARGE CAPACITY REVERSE OSMOSIS (RO) AND MULTISTAGE FLASH (MSF) SEAWATER DESALTING PLANTS,
Kuwait Univ., Safat. Dept. of Mechanical Engineering.
M. A. Darwish.
Desalination DSLNAH, Vol. 63, p 143-161, June 1987. 3 fig, 1 tab, 4 ref.

Descriptors: *Water treatment facilities, *Desalination, *Reverse osmosis, *Multistage flash distillation, *Energy, *Seawater, Comparison studies, Capital costs, Corrosion, Construction costs, Operating costs, Maintenance costs, Pretreatment of water, Membranes, Water quality, Leakage, Powerplants, Steam turbines.

The application of reverse osmosis (RO) to desalting seawater began commercially in 1973; it is expanding quickly and is competing with highly-developed and reliable multistage flash distillation (MSF) systems. The claimed advantages of RO systems over MSF systems are energy efficiency; lower capital cost; shorter construction time; fewer corrosion problems; simplicity of construction, operation, and maintenance; smaller space requirements; etc. On the other hand, some RO disadvantages are the requirement for substantial water pretreatment; uncertainties of membrane life and membrane cycle; lower product water quality; continuous decay in product water flux; many unforseen operational problems; and the proliferation of small equipment with thousands of possible leakage points. This paper compares energy consumed by seawater RO and MSF desalting plants when the latter are combined with steam powerplants (i.e., dual-purpose power and desalting plants). To overcome the proliferation of small equipment in large RO plants, a scheme is presented which enlarges the high-pressure pump of the RO system, combines it with a steam powerplant, and drives it with a steam turbine. Also presented is a scheme which combines a hybrid MSF/RO desalting system with a steam powerplant. (Shidler-PTT)
W88-07238

PERFORMANCE EVALUATION OF THREE DIFFERENT SEAWATER RO MEMBRANES AT DROP IN KUWAIT,
Water Resources Development Centre, M. E. W., P. O. Box 12020 Shamiya, 71651 Shamiya, Kuwait.
A. L. A. Malik, K. M. Mousa, N. G. Younan, and B. J. R. Rao.
Desalination DSLNAH, Vol. 63, p 163-192, June 1987. 17 fig, 4 tab, 7 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Desalination, *Desalination apparatus, *Desalination plants, *Membrane processes, *Reverse osmosis, Kuwait, Comparison studies, Performance evaluation, Permselective membranes, Cellulose acetate membranes, Pretreatment of water, Salt rejection, Doha Reverse Osmosis Plant, Conductivity, Persian Gulf.

Kuwait has realized that in spite of the success achieved in desalination of normal seawater by reverse osmosis (RO), additional problems are presented by Arabian Gulf seawater, which has higher total dissolved solids, silt density, and temperature. Hence, a joint program between the Water Resources Development Centre of Kuwait, the Kuwait Institute for Scientific Research, and GKSS of the Federal Republic of Germany has been established in Kuwait to carry out the operation of three independent reverse-osmosis lines each of 1000 cubic meters per day capacity; these lines, at the Doha Reverse Osmosis Plant (DROP), are operated in parallel. The seawater membranes used in the first stage of the three lines are: spiral-wound UOP-1501, hollow fine-fiber Dupont B-10, and plate and frame membranes of Enro, Schleicher and Schull (RO 112), and Filmtec (FT-30). The membranes used in second stage are spiral-wound UOP-8600, hollow fine-fiber Dupont B-9, and spiral-wound Hydronautics 8040B, respectively. The average overall recovery ratios for lines 1 to 3 were 24.8, 24.1, and 29.6%, compared with design values of 27, 25, and 32%. First stage salt rejection for lines 1 and 2 was about 85 and 98.4; rejection values for the second stage of these lines were about 90 and 95%. In line 3, the Filmtec membranes were found to have a constant permeate conductivity while permeate conductivity of the Enro and Schleicher & Schull membranes increased, affecting overall performance; performance was improved by replacing some Enro membranes by Filmtec membranes. The average values of power consumption for lines 1 and 3 (with energy recovery) were about 10.6 and 18 KWH per cubic meter; power consumption (without energy recovery) for line 2 was about 13.5 KWH per cubic meter. The average availability of lines 1 to 3 was 92.8, 89.5, and 85.2%, respectively. (Shidler-PTT)
W88-07239

OPERATION AND MAINTENANCE OF REVERSE OSMOSIS WATER DESALINATION PLANT OF THE KUWAIT OIL COMPANY,
Kuwait Oil Company, Kuwait.
Z. M. Shallal.

Desalination DSLNAH, Vol. 63, p 193-208, June 1987. 14 fig, 6 tab, append.

Descriptors: *Water treatment, *Water treatment facilities, *Desalination, *Desalination plants, *Desalination apparatus, *Membrane processes, *Reverse osmosis, Kuwait, Brackish water, Groundwater, Potable water, Operating policies, Maintenance, Performance evaluation, Personnel, Backwash, Pumps, Chemical treatment.

In 1981 two brackish groundwater reverse-osmosis water desalination plants were commissioned to supply drinking water for the Kuwait Oil Company (KOC) residential area. This paper presents the operation, maintenance, and performance of these 600,000 IGPD plants for a period of more than five years. It highlights the weak areas of the process, difficulties faced, and corrective actions taken. A plant is attended by a single operator; additional staff consists of a 'day duty controller' and the plant engineer. Electrical and instrument maintenance is undertaken by contract personnel under the direct supervision of KOC; mechanical maintenance is carried out totally by KOC. One plant was equipped with an automatic backwash system while the other is manual; as a result of frequent timer failures, jamming valves, and other malfunctions, the automatic system was converted to manual backwash. One of the plants uses conventional 2900-rpm multi-stage centrifugal pumps with a common standby for the 3 trains; the other plant has no standby and uses high-speed single-stage units which have high noise levels and are less reliable. The major problems experienced with the reverse-osmosis membrane units have been with the end caps and interconnecting 'O' ring seals on the product tubes. The major chemical treatment problem resulted from the small mixing tank size, limiting space for precipitation of solids and resulting in blockage of the injection tubes by undissolved solids; maintaining a 5% solution of soda ash or sodium hexametaphosphate solved the problem. (Shidler-PTT)
W88-07240

EXPERIENCE AND RESULTS ON THE OPERATION OF THE COMMON PRETREATMENT AT DROP,
Southeast Kansas Branch Experiment Station, Parsons.
J. Grigoleit, and B. Schoettler.
Desalination DSLNAH, Vol. 63, p 209-215, June 1987. 2 fig, 3 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Pretreatment of water, *Desalination plants, *Reverse osmosis, Performance evaluation, Doha Reverse Osmosis Plant, Kuwait, Flocculation, Filtration.

Within the scope of a joint research program between the Kuwait Institute for Scientific Research, the Water Resources Development Centre Kuwait, and the GKSS Research Center, Federal Republic of Germany, the Doha Reverse Osmosis Plant (DROP), with total capacity of 3000 cubic meters per day is being operated in Kuwait. The plant comprises three lines, equipped with different types of modules (spiral-wound, hollow fine-fiber, and plate and frame). The raw water for all 3 units is processed in one pretreatment device. If necessary, additional pretreatment stages are installed for the individual reverse osmosis lines. The plant described in this paper uses the so-called Wahnbach Process--pretreatment is effected by flocculation and filtration via multilayer filters. For more than two years now this plant has been operated with high availability. The pretreated water can be used for plate and frame as well as spiral-wound modules. For the line equipped with hollow fine fibers, an additional pretreatment stage is necessary. (See W88-07242 thru W88-07244) (Author's abstract)
W88-07241

EXPERIENCE AND RESULTS ON THE OPERATION OF THE SPIRAL WOUND MODULE LINE OF DROP,
Krupp Industrietechnik G.m.b.H. - Werk Buckau Wolf, Grevenbroich (Germany, F.R.).
J. Grigoleit, and B. Schoettler.
Desalination DSLNAH, Vol. 63, p 217-223, June 1987. 5 fig.

Descriptors: *Water treatment, *Water treatment facilities, *Membrane processes, *Reverse osmosis, *Desalination, *Desalination apparatus, *Desalination plants, Performance evaluation, Doha Reverse Osmosis Plant, Kuwait, Seawater.

Within the scope of a joint research program between the Kuwait Institute for Scientific Research, the Water Resources Development Centre Kuwait, and the GKSS Research Center, Federal Republic of Germany, the Doha Reverse Osmosis Plant (DROP), with total capacity of 3000 cubic meters per day is being operated in Kuwait. The plant comprises three lines, equipped with different types of membrane modules (spiral-wound, hollow fine-fiber, and plate and frame). This report describes one of the three lines, comprising a seawater desalination plant processing 1000 cubic meters per day and refining untreated water with salt content of approximately 45,000 mg/kg to water with less than 500 mg/kg. This plant is a two-stage unit equipped with spiral-wound modules. For more than two years now the plant has been operated reliably and its availability is 97%. (See also W88-07241) (Author's abstract)
W88-07242

SEAWATER DESALINATION WITH POLYAMIDE HOLLOW FIBRE MODULES AT DROP,
Hager und Elsaesser GmbH, P. O. Box 80 05 40 (Ruppmannstrasse 22), Germany.
R. Nagel.
Desalination DSLNAH, Vol. 63, p 225-246, June 1987. 11 fig, 2 tab, 2 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Reverse osmosis, *Membrane processes, *Desalination, *Desalination apparatus, *Desalination plants, Performance evaluation, Kuwait, Seawater, Pretreatment of water, Scaling, Fouling, Chemical treatment, Doha Reverse Osmosis Plant.

The Doha Reverse Osmosis Plant (DROP) for seawater desalination has now been in operation for a little more than two years. The main objectives of the research program have been achieved in all details: (1) investigation of the effectiveness of pretreatment, with particular regard to the requirements of hollow-fiber membranes; (2) demonstration of reliable long-term operation of reverse osmosis in seawater desalination; (3) determination and recording of operational data; (4) determination of the operating conditions at which scaling and fouling do not occur; (5) investigation of membrane-cleaning methods; and (6) determination of the amounts of chemicals required for long-term operation. (See also W88-07241) (Author's abstract)
W88-07243

VERIFICATION OF DESIGN CRITERIA, EXPERIENCE, AND RESULTS OBTAINED WITH THE PLATE MODULE LINE AT DROP, KUWAIT,
Water Treatment Department, L. und C. Steinmueller GmbH, P. O. Box 10 08 55, 5270 Gummersbach, West Germany.
W. Nieszen.
Desalination DSLNAH, Vol. 63, p 247-262, June 1987. 9 fig, 3 tab, 6 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Desalination, *Desalination plants, *Desalination apparatus, *Membrane processes, *Reverse osmosis, *Design criteria, Kuwait, Seawater, Potable water, Operating policies, Performance evaluation, Cellulose acetate membranes, Control systems, Automation, Chemical treatment, Doha Reverse Osmosis Plant.

The essential objective of the plate module line at Doha Reverse Osmosis Plant (DROP) is to test the plate module system with various types of membrane (A, B, and C) in desalination stage I of a two-stage reverse osmosis seawater desalination plant, designed for a nominal potable water capacity of 1000 cubic meters per day at 40% recovery. After a general description of the plate module line, the design criteria of desalination stage I in particular are compared with the results of the first two years' operation converted to standard conditions. In view of the substantial differences in performance between the membrane type C, a thin film composite membrane, and types A and B, which both belong to the class of integrally asymmetric phase inversion membranes on a cellulose acetate base, the operating results for a 1000 cubic meters per day plate module plant are extrapolated solely on the basis of a type C membrane in desalination stage I. Experience with other plant components includes desalination stage II with spirally-wound module elements, the energy recovery system, materials employed, and the fully-automatic control system. (See also W88-07241) (Author's abstract)
W88-07244

STUDIES ON REMOVAL OF MALATHION FROM WATER BY MEANS OF ACTIVATED CHARCOAL,
Aligarh Muslim Univ. (India). Chemistry Section.
For primary bibliographic entry see Field 5F.
W88-07497

NON-CONVENTIONAL WATER RESOURCES USE IN DEVELOPING COUNTRIES.
For primary bibliographic entry see Field 3C.
W88-07850

OVERVIEW OF NON-CONVENTIONAL WATER RESOURCES IN DEVELOPING COUNTRIES,
United Nations, New York. Dept. of International Economic and Social Affairs.
M. Brewster.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 31-36, 1 tab.

Descriptors: *Wastewater renovation, *Weather modification, *Water transport, *Water reuse, *Developing countries, Water resources developmnet, Economic aspects, Comparison studies, Costs, Water costs, Cost analysis, Cloud seeding, Distillation, Reverse osmosis, Electrodialysis.

A brief overview of non-conventional water resources in developing countries is given along with a comparison of the four main non-conventional water resource technologies (desalination, wastewater reuse, weather modification, and transport of water by tankers). The costs of any of these technologies are difficult to determine with accuracy and are not comparable from place to place. No single non-conventional solution is suitable to all water-short areas. In any situation where a conventional source of water can be developed, it will usually be preferred to a non-conventional source. Non-conventinal water resources are generally more complex in development and operation than conventional sources, and are usually more expensive. The major markets in developing countries for non-conventional water resources are the Middle East and North Africa and islands of the Caribbean, Mediterannean and North Atlantic. Of the four main non-conventional technologies studied, various desalination processes including distillation, reverse osmosis and electrodialysis have proved to be commercially viable, reliable techniques for removing the salt from brackish and sea waters. The future of tanker transport of water is a matter of economics under existing market conditions. The future prospect for the widespread application of wastewater reuse in developing countries depends on several factors: wastewater collection systems, public health aspects, cultural acceptance, and treatment of effluents to minimize pollution. The complex variables involved in weather modification will probably hinder its widespread application for increasing rainfall in most areas in the near future. The increasing demands for water and increasing costs of developing sources and supplies by conventional means will provide opportunities for the economic application of non-

conventional water resource techniques. (See also W88-07850) (Geiger-PTT)
W88-07851

INTRODUCTION TO DESALINATION,
CH2M Hill Southeast, Inc., Gainesville, FL. Water Resources Div.
O. K. Buros.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 37-53, 7 fig, 1 tab, 7 ref.

Descriptors: *Desalination, *Reverse osmosis, *Electrodialysis, *Developing countries, *Distillation, Multistage flash distillation, Separation techniques, Saline water, Seawater, Water resources development, Demineralization, Cost analysis, Membrane processes, Freezing.

Desalination is a separation process that treats saline water to reduce the dissolved salt content to a usable level. The three major desalination processes are distillation, electrodialysis, and reverse osmosis. Electrodialysis and reverse osmosis are used for desalting brackish water, while reverse osmosis and distillation are used to desalinate seawater. Distillation is the oldest and most commonly-used method of desalination. The commercial development of land-based seawater distillation units took place in the late 1950's with the development of the multistage flash (MSF) concept. MSF plants have been extensively used in the Middle East, North Africa and the Caribbean. Two other distillation processes of importance for potable water production are multiple-effect and vapor compression. Electrodialysis is a membrane separation process of desalination. Reverse osmosis is a membrane separation process in which the water from a pressurized saline solution is separated from the solutes by flowing through an appropriate membrane. Two other desalination processes of interest are freezing and membrane distillation. Freezing has considerable advantages over distillation but the process is cumbersome, and has never been a commercial success. In membrane distillation, a special membrane allows the passage of water vapor but not liquid. This process is relatively new and its commercial success is not yet known. The major costs of production for all of the processes are energy, labor and amortization of capital costs. With the reverse osmosis and electrodialysis processes, membrane replacemnt costs are also significant. Desalination processes must prove economically feasible in the planning stage before such projects are undertaken. (See also W88-07850) (Geiger-PTT)
W88-07852

RECENT DEVELOPMENTS IN VAPOUR COMPRESSION DESALINATION,
Societe Internationale de Dessalement, Paris (France).
M. Lucas.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 54-59, 1 fig, 3 tab.

Descriptors: *Multieffect distillation, *Distillation, *Desalination, *Water vapor, *Vapor compression distillation, Multistage flash distillation, Operating costs, Cost analysis, Seawater, Brines, Desalination wastes, Developing countries, Evaporation.

Where smaller size distillation procedures are needed for desalination of seawater, multi-effect vapor compression processes working at low temperature (around 60 degrees) with a spray-film evaporator are useful. The multi-effect process saves energy by its spray-film and cross-tube evaporator configuration. No pre-treatment of the seawater is needed and the low temperature of the process helps to avoid problems of scaling and corrosion. The compactness of the skid-mounted units means lower investment, transportation and erection costs. Several standard skid-mounted package units are in operation in the Caribbean. The water cost is dependent on a number of factors. Examples of cost variation of one unit using multi-stage flash, ejecto- or mechanical compression are given. A flow diagram of the ejecto-compression process is provided. In the first cell, part of the seawater is vaporized and remaining brine flows into the bottom of cell 2. The vapor produced in cell 1 flows into the tubes of heating bundle F2 where it is condensed. While condensing in the heating bundle F2, the vapor gives up sufficient heat to vaporize an equivalent quantity of seawater being sprayed over the bundle. In evaporators with more than 2 cells, the process is repeated in all the remaining cells. In the last cell, part of the vapor is condensed over the condenser bundle, thus heating up the seawater that flows through the condenser. The remaining vapor is sucked and compressed by an ejecto-compressor using steam supplied by a boiler or an external source. On leaving the ejecto-compressor the mixed motive steam and vapor is delivered into the heating bundle F1 where it is condensed by transmitting a sufficient amount of heat to evaporate the seawater. To prevent too high a concentration of dissolved salts in the evaporation chambers, the quantity of make-up seawater is greater than the distillate production. Excess brine is drained from the bottom of the last cell. The unit includes a vacuum system which consists of either a steam- or a water- ejector. In the case of mechanical compression, the ejector is replaced by a centrifugal compressor, and plate heat exchangers are installed on both brine reject and distillate production lines to heat up the seawater. (See also W88-07850) (Geiger-PTT)
W88-07853

RECENT DEVELOPMENTS IN REVERSE OSMOSIS,
Basic Technologies, Inc., Riviera Beach, FL.
P. L. Culler.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 60-65.

Descriptors: *Desalination, *Reverse osmosis, *Membrane processes, *Semipermeable membranes, *Developing countries, Cellulose acetate membranes, Potable water, Water supply development, Maintenance costs, Separation techniques, Seawater, Saline water, Polymers.

The use of semi-permeable membranes for separating salt from water by reverse osmosis has come a long way since the late 1950's when serious research on this method of desalination began. Typical brackish installations today are capable of separating 98% of the salt from feed waters with total dissolved solid levels of 2500-3000 mg/l using pressures of 200-250 psig with a flux of 16 gal/sq ft/day and a 5-year period before membrane replacement is required. Cellulose acetate and polyamide type membranes are giving way to new thin film composite membranes. The new membranes work within a wider pH range, at higher temperatures and with broader chemical parameters. Recovering energy from the system's reject stream is being carried out by pelton wheels, reverse running pumps and other innovations. Applications utilizing reverse osmosis are being developed and refined for potable, industrial and agricultural uses. Reverse osmosis plants will find future use in treating polluted waters for potable water use in small villages in developing countries. Extensive research continues in the food and pharmaceutical industry for use of reverse osmosis as a unit process tool where concentration and fractionation of a wet process stream is needed. Desalted water from reverse osmosis operations can be used as irrigation water to improve the yield of crops. Operating experience with reverse osmosis technology has improved over the past 15 years. The advantages of reverse osmosis technology include its simplicity, packaging, ease of installation, small space requirements, use of durable materials for its construction, and low operation and maintenance costs. The main disadvantages of reverse osmosis technology are the short life of membranes, and need for pre-treatment of water. The capital cost of desalting seawater by reverse osmosis has been moving on a downaward trend as new membranes are developed. (See also W88-078950)(Geiger-PTT)
W88-07854

DESALINATION WITH RENEWABLE ENERGY SOURCES,
Faculty of Engineering, Brace Research Inst., Macdonald Coll. of McGill Univ., Quebec.
T. A. Lawand.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 66-86, 3 fig, 5 tab, 46 ref.

Descriptors: *Desalination, *Energy, *Operating costs, *Developing countries, *Solar energy, Multistage flash distillation, Distillation, Electrodialysis, Freezing, Reverse osmosis, Comparison studies, Biomass, Literature review, Tidal energy, Seawater.

The role of renewable energies in meeting the energy needs of desalination processes is reviewed. Using low density energy sources such as solar or wind energy should be considered very carefully due to the significant amount of energy required in desalination. A comparison of equivalent energy usage in various desalination systems is listed for the following desalination processes: reverse osmosis, hyperfiltration, distillation, electrodialysis, solar distillation, and freezing processes. Several forms of renewable energy sources that may be applied to desalination processes are discussed: solar energy, wind energy, biomass energy, and tidal energy. The availability of each renewable energy must be known before these technologies can be applied to desalination processes. The desalination system must be operated and managed by a well-organized structure to ensure success. It is highly recommended that any desalination system utilizing renewable energy sources be combined with a suitable freshwater management policy to ensure that the freshwater is adequately used. Available technologies involving reverse osmosis for desalination may be categorized as manual, mechanical drive linked to windmill, or solar-powered systems. The Soleras solar energy desalination project, one of the prime projects conceived for the utilization of renewable energy technologies for desalination purposes, is described. The project, a joint Saudi Arabian/United states effort, would provide two brackish water treatment plants for the United States and three seawater desalination plants for Saudi Arabia. (See also W88-07850) (Geiger-PTT)
W88-07855

FACTORS INFLUENCING THE ECONOMICS OF DESALINATION,
Little (Arthur D.), Inc., Cambridge, MA.
J. D. Birkett.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 87-103, 4 fig, 12 tab, 7 ref.

Descriptors: *Desalination, *Capital costs, *Operating costs, *Water costs, *Cost analysis, Maintenance costs, Pricing, Economic aspects, Developing countries, Vapor compression distillation, Distillation, Reverse osmosis, Brackish water, Seawater.

Several tables and figures are presented which elaborate upon the background document for this Conference (Water Series No. 14) and suggest several conclusions which may be drawn. Tables include: typical seawater desalting plant costs and brackish water desalting plant costs (both capital costs and operating costs); general cost ranges for desalination; costs of desalination by vapor compression; desalting plant capital costs (both direct and indirect costs); desalting plant annual costs; typical percentage contribution of cost components to total annual costs of desalting plants; seawater reverse osmosis costs as a function of electricity costs; fuel consumption in single-purpose (water production only) desalination plants; effect of recovery ratio on high pressure reverse pumping energy; effect of recovery ratio on feed water

pumping costs; and privatization as an option for plant ownership and operation. Figures include: initial cost of some small marine desalinators on the market (graph); trends in capital and total water costs for desalination facilities (graph); the components of desalination equipment costs; and factors involved in calculating desalinated water costs. In conclusion, the tables and figures should serve as a reminder that: there exists a 'menu' of established technologies to serve various desalting needs; each technology is available in a broad range of capital and operating costs, dependent upon site-specific factors and prevailing economic and competitive conditions; any single price (or cost) is the result of trade-offs made in overall design; and in many cases, desalination costs will be sufficiently competitive with alternate sources of supply to warrant serious consideration of the desalination option. (See also W88-07850) (Geiger-PTT)
W88-07856

ASPECTS OF PROCESS SELECTION FOR DESALINATION,
Glasgow Univ. (Scotland). Dept. of Mechanical Engineering.
R. S. Silver.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 104-118, 2 ref, append.

Descriptors: *Desalination, *Distillation, *Water resources development, *Multistage flash distillation, *Reverse osmosis, Water reuse, Membrane processes, Separation techniques, Developing countries, Design criteria, Economic aspects.

In choosing a desalination process for any new project, the major considerations must be the technologies of the respective processes. One of the major criteria for selection of a process is likely to be its energy consumption. When desalination only is required, and when it cannot conveniently be coupled to use extraction steam from an existing power station, reverse osmosis (RO) will give a large savings in energy consumption compared with thermal distillation. Processes for desalination should be, above all other considerations, reliable. They should be morphologically simple and easy to maintain. Some important differences between the multistage flash distillation process (MSF) and reverse osmosis are discussed. The basic difference is that the materials used in MSF have very little effect on the essentials of the process, whereas in RO the very possibilty of the process occurring depends precisely on the availability of a specific material. A second important difference between the two processes is that the heat transfer behavior in MSF is relatively unaffected by trace substances in the water. The simultaneous existence of these two differences implies that RO is subject to much greater risk of performance failure than MSF unless the quality control im membrane manufacture, maintenance of that quality in storage, shipment, and installation, are extremely good. MSF is capable of attaining a total dissolved solids level of < 50 ppm while RO achieves about 200 ppm of total dissolved solids from seawater. In RO the recovery possible from seawater is about 30%. Some development limitations and possibilities in MSF are outlined. The energy consumption has been restricted to values poorer than are technically possible. Corrosion resistant materials must be used on the process stage walls. The operation of small scale desalination units and the relation of desalination to water reuse is also discussed. (See also W88-07850) (Geiger-PTT)
W88-07857

TRANSPORT OF DRINKING WATER IN SEGREGATED BALLAST TANKS,
Municipal Waterworks of Rotterdam (The Netherlands).
For primary bibliographic entry see Field 5F.
W88-07860

DUAL WATER SYSTEMS IN THE UNITED STATES VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W88-07871

BERMUDA: APPLICATION OF NON-CONVENTIONAL WATER RESOURCES,
Public Works Dept., Hamilton (Bermuda).
For primary bibliographic entry see Field 3C.
W88-07872

CAYMAN ISLANDS: COUNTRY SITUATION REPORT,
The Water Authority, P.O. Box 1104, Grand Cayman.
R. G. B. Beswick.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 338-348, 2 fig, 2 tab.

Descriptors: *Cayman Islands, *Water supply development, *Water reuse, *Water harvesting, *Desalination, Wastewater disposal, Water transport, Cesspools, Septic tanks, Cost analysis, Potable water, Catchment areas, Water storage, Wastewater irrigation, Groundwater pollution, Water demand.

The Cayman Islands have developed to the point where they now are a successful tourist and business center, utilizing completely non-conventional water resources. Households have satisfied their own water needs by roof catchment systems. Treatment and disposal of wastewater is accommodated on-site by either septic tank or cesspit. In more developed areas, the large number of properties utilizing on-site sewage disposal is a great risk to grounwater quality. Rain water storage systems are also not free from the risk of contamination. The efficiency of individual rain water catchment systems is a function of rainfall, roof area, catchment equipment and demand. The construction costs of rain water catchment systems are high. The cost of a bored well is currently CI$15 per foot for a 5-inch bore. A private water company provides desalinated water at CI$15.87 per 1,000 US gallons plus a fuel adjustment factor. Seven companies operate as water truckers. Their prices range from CI$3.80 to CI$4.58 per 1,000 US gallons plus a fuel adjustment factor. The Water authority is developing plans to provide the developed areas of the island with a public piped water supply. A joint venture with the Electricity Generating Company to utilize waste heat for distillation of water is under way, and a feasibility report is being prepared. Estimates for future water demands for the island are discussed. Treated effluent from a propsed sewage treatment works will be used to irrigate properties along the West Bay Beach area. (See also W88-07850) (Geiger-PTT)
W88-07873

CYPRUS: DEVELOPMENT OF NON-CONVENTIONAL WATER SOURCES,
Department of Water Development, Nicosia (Cyprus).
S. A. Theodosiou.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 354-359, 1 fig.

Descriptors: *Cyprus, *Desalination, *Water reuse, *Cloud seeding, *Water supply development, Groundwater mining, Water demand, Wastewater renovation, Wastewater treatment, Recycling, Wastewater irrigation, Potable water, Water use, Saline water intrusion, Weather modification.

Cyprus is an agricultural country where irrigation has been practiced for over 2,000 years. Uncontrolled pumping of groundwater from aquifers has resulted in depletion of supplies and saline water intrusion into some of the aquifers. Increases are expected in the amount of water needed for irrigation and for domestic use. The Government of Cyprus decided to develop three alternative nonconventional water resources: sea and brackish water desalination, reclamation of sewage, and cloud seeding. Reverse osmosis processes proved successful in producing a high quality water suitable for potable purposes, but lack of trained personnel caused loss of performance in almost all of the desalination plants. Strict laws were passed by the Government making it obligatory to treat all sewage by conventional sewage treatment plants. The laws also restricted the disposal into the sea of any sewage, even of treated effluent, to control pollution of the beaches. Improvement of the effluent by the addition of secondary or tertiary treatment made it usable for irrigation water for hotel gardens. The Agriculture Institute of Cyprus is experimenting on the growing of cotton and animal foodstuffs with wastewater irrigation. Results of cloud seeding experiments were insignificant and such research had to be abandoned. Of the non-conventional water resources considered for exploitation in Cyprus, only those provided by desalination for the production of high quality water for domestic and industrial use and sewage recycling for irrigation have so far proven to be of practical importance. (See also W88-07850) (Geiger-PTT)
W88-07875

ETHIOPIA: SOME NON-CONVENTIONAL WATER RESOURCE TECHNOLOGIES,
Research and Development in Rural Pumping Technologies, Ethiopian Water Works Construction Authority, P.O. Box 385, Addis Ababa (Ethiopia).
B. A. Mammo.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 360-370, 2 fig, 4 ref.

Descriptors: *Ethiopia, *Water supply development, *Pumping, *Desalination, *Remote sensing, Shallow wells, Developing countries, Groundwater mining, Rural areas, Deep wells, Solar energy, Potable water, Pumps, Dams, Satellite technology, Mapping, Aerial photography, Site selection.

Some of the relatively new methods of water supply and methods of identifying water resources that are being experimented with in Ethiopia are described. The Rural Pumping Technology Research and Development Project, being undertaken in collaboration with the Faculty of Technology Addis Ababa University is studying handpumps for extraction of groundwater from shallow and deep wells, windpower for pumping, and solar desalination. Project financing has been with assistance from the International Development Research Center of Canada, SAREC of Sweden and previously UNDP/UNIDO. Research and development work being undertaken in the Eastern Region of Ethiopia, with financial assistance from the Swedish International Development Agency (SIDA) and VIAK AB of Sweden as consulting engineers includes remote sensing for water resources development, groundwater dams, and shallow wells. Satellite and aerial photography are being used for collecting hydrologic data on wet and dry seasons and mapping of various hydrogeologic areas. No information was available on shallow wells. (See also W88-07850) (Geiger-PTT)
W88-07876

TURKS AND CAICOS ISLANDS: BRIEF NOTES ON WATER SUPPLIES,
Ministry of Works and Utilities, Nassau (The Bahamas).
K. F. Sparkes.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 381-387, 1 fig, 1 tab, 3 ref.

Descriptors: *Desalination, *Turk Islands, *Caicos Islands, *Water harvesting, *Water transfer, Distillation, Solar energy, Reverse osmosis, Water supply development, Groundwater mining, Water storage, Potable water, Developing countries, Storage tanks, Water demand, Water use.

In the Turk and Caicos Islands all water supplies are essentially non-conventional. The traditional source of domestic water is the house roof catchment and storage tank. Storage tanks represent a large initial monetary outlay, and some of the poorer members of the community need some assistance in obtaining safe storage tanks. Supplementary water supplies are often required to cover basic deficiencies and demands during extensive drought. Such supplies are derived from public rain water catchments; fresh groundwater lenses; brackish groundwater deposits desalinated by reverse osmosis; seawater desalinated in distillation plants or by high pressure reverse osmosis; and barging of water from islands having spare capacity or from abroad. The main advantages and disadvantages of each method are tabulated. Data on water supplies and usage are enumerated for the islands of Grand Turk, South Caicos, Salt Cay, other Caicos islands, and providenciales. (See also W88-07850) (Geiger-PTT)
W88-07878

BAHRAIN: TRAINING OF STAFF FOR DESALINATION PLANTS,
Ministry of Works, Power and Water, State of Bahrain.
S. A. R. Khalaf.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 388-401, 3 fig, 3 tab, 2 tab.

Descriptors: *Desalination, *Bahrain, *Training, *Manpower, *Personnel, Maintenance, Management planning, Education, Labor, Personnel management, Design criteria, Operating costs, Capital costs.

To overcome problems of deterioration of groundwater quality in the State of Bahrain, a long-term plan was formulated for the construction of desalination plants. Difficulties arose in obtaining manpower to operate the plants. Regional assistance was sought from the state of Kuwait for training some Bahraini nationals in the art of operating desalination plants. Local engineers were encouraged to enroll in professional institutions and to participate in relevant international conferences that addressed desalination technology innovation. The desalination project contractor's personnel were used to cover for the unavailable qualified local staff required to run newly built desalination facilities. Typical training programs for desalination personnel include an induction course (duration 6 months), a basic course (duration 6 months), and a specific course in desalination operations (duration 12 months). Training methodology and problems in training are discussed. Technology transfer is of importance to ensure sustained improvement in desalination technology. The Ministry of Works, Power and Water has, over the past ten years, been able to run its first two distillers by Bahraini staff. (See also W88-07850) (Geiger-PTT)
W88-07879

CAPE VERDE ISLANDS: EXPERIENCES WITH SEA-WATER DESALINATION,
Electra, EP, S. Vicente, Cape Verde Islands.
S. Morais.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 402-412, 1 fig, 2 tab.

Descriptors: *Desalination, *Reverse osmosis, *Multistage flash distillation, *Cape Verde Islands, *Seawater, Water costs, Comparison studies, Training, Personnel, Distillation, Corrosion, Performance evaluation, Sand filters, Evaporation, Scaling.

Seawater desalination plays an important role in the development of Cape Verde's water resources. It is utilized on a large scale and will shortly be extended to most of the islands. The main features of the existing desalination plants are described. The Babcock plant in Sao Vicente uses evaporation. Acid treatment, high temperatures and poor design make the control of scale and corrosion very difficult. The Esmil plant, also in Sao Vicente, uses multistage flash distillation. It also suffers from corrosion problems, but it is difficult to shut the plant down for maintenance. In Sal, the aiport desalination plants use vapor compression and the Santa Maria plant uses multistage flash distillation. Reverse osmosis plants in Sal are found in Palmeira and the hotel Morabeza. Faulty design and failure of plant parts have caused poor performance in these plants as well. Costs of water from the desalination plants of the Cape Verde Islands are relatively high. While multistage flash distillation plants suffer from a lack of trained personnel, reverse osmosis methods require pretreatment of water and occasional membrane replacements. From the mistakes and problems encountered with desalination in the Cape Verde Islands, much has been learned to make new ventures more successful in the future. (See also W88-07850) (Geiger-PTT)
W88-07880

CURACAO: DRINKING WATER SUPPLY,
Water and Power Corporation, P.O. Box 2097, Curacao, Netherlands Antilles.
H. T. M. Gouverneur.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 413-417, 1 fig, 1 tab.

Descriptors: *Desalination, *Distillation, *Curacao, *Drinking water, *Multistage flash distillation, *Financing, *Pricing, Water supply development, Evaporation, Water costs, Electric power production, Reverse osmosis.

To meet increasing demands for freshwater, the island of Curacao in 1928 installed a submerged tube distillation plant for converting seawater into drinking water. In 1959 it became possible to couple water production with electricity production by using steam from the turbines to supply heat to the submerged tubes. In 1963, two multistage flash (MSF) evaporators were installed with a capacity of 6,000 cu m/day each. Because of the relatively small water storage capacity of the island, and the unreliability of some of the production units, water supply has been through critical periods repeatedly in the recent past. Water samples are now taken several times a day and are analyzed to ensure water quality. Several problems are associated with water supply in Curacao. High fuel costs cause high water and electricity prices. The maintenance of the evaporators is both a financial and a technical problem. High investments have to be made for larger and more efficient production units to keep ahead of the increasing demand for water. Unaccounted-for water is estimated at 30%. The water distribution network is not well balanced giving some areas a shortage of water while other areas experience a surplus. The water storage capacity has to be increased to at least 250,000 cu m. Favorable financing arrangements for new projects are difficult to obtain. Several strategies are suggested to overcome financial problems. They include: investing in more efficient and reliable units to reduce production costs; operating the existing units as efficiently as possible; reorganizing the water distribution company's system of collecting fees in order to reduce outstanding accounts receivable; and reducing unaccounted-for water. Mathematical models for water resources optimization (balancing of distribution network) and experience in seawater desalination with reverse osmosis are also recommended. (See also W88-07850) (Geiger-PTT)
W88-07881

INDIA: OVERVIEW OF WATER DESALINATION RESEARCH FOR SUPPLYING WATER TO SOME AREAS AFFECTED BY SALINITY,
Central Ground Water Board, Jamnagar House, Mansingh Road, New Delhi 11, India.
B. P. C. Sinha.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 418-424, 1 fig, 2 ref.

Descriptors: *Desalination, *India, *Reverse osmosis, *Distillation, *Electrodialysis, Freezing, Vapor compression distillation, Water supply development, Rural areas, Ion exchange, Solar distillation, Evaporation, Multistage flash distillation, Saline water intrusion.

Every citizen of India is to be provided with a safe drinking water supply by the end of the International Drinking Water Supply and Sanitation Decade, in 1990. To identify the rural areas which needed immediate attention, a country-wide survey was conducted. In areas where the groundwater was contaminated by saline water intrusion, desalination practices were adopted. The various desalination processes that have so far been tried in India are: submerged-tube distillation, multistage flash distillation, vertical tube evaporation, horizontal-tube multi-effect process, solar distillation, vapor compression distillation, freezing, reverse osmosis, electrodialysis, ion exchange, solvent extraction, and hydrate process. Water desalination research is principally carried out by the Central Salt and Marine Chemicals Research Institute (CSMCRI); the Bhabha Atomic Research Center (BARC); and the Defense Laboratory. The CSMCRI has constructed two solar stills on the roof of a garage to supply distilled water. Two solar plants were set up in Gujarat under the 'science for villages' program. A 3-stage flash distillation facility was set up at BARC. A 33-stage multistage flash distillation plant is under construction and vertical-tube evaporation plants are being operated. Reverse osmosis plants have also been successful for the the desalination of brackish water. The Defense Laboratory and CSMCRI have experimented with electrodialysis. Cost estimates for reverse osmosis and electrodialysis plant operations are listed. (See also W88-07850) (Geiger-PTT)
W88-07882

MEXICO: WATER DESALINATION EXPERIENCES,
O. P. Siller.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 425-429, 4 ref.

Descriptors: *Desalination, *Mexico, *Solar distillation, *Reverse osmosis, *Multistage flash distillation, Vapor compression distillation, Distillation, Water supply development, Saline water, Water use, Industrial water, Municipal water, Developing countries.

In arid regions of Mexico where groundwater supplies of freshwater are being depleted, desalination may be a competitive and appropriate technology. Desalination for municipal freshwater supply purposes started in Mexico in the late 1960's. In 1971 the Commission for the Utilization of Saline Waters was created within the Federal Government structure as part of the Water Resources Ministry in order to design, build, install and operate desalination plants. In 1976, the commission was transformed into the General Directorate of Utilization of Saline Waters. Since 1971 about 65 single-purpose service or experimental plants have been installed. Reverse osmosis is mainly used for desalination of brackish water and distillation is mostly used for seawater. Most plants are installed in isolated locations where erection is difficult and fuels, parts, chemicals, and labor are scarce. Industrial uses of desalinated water are more important and more extensive than municipal uses. Desalination plants using the various processes have been manufactured to a lesser or greater degree in Mexico and all of them are operated by Mexicans. Manufacturing capacity for multistage flash distillation evaporators is available in several places where powerplant equipment is fabricated. Some reverse osmosis and vapor compression plants are partially fabricated in the country. Some criteria employed for desalination process selection are discussed. (See also W88-07850) (Geiger-PTT)
W88-07883

MOROCCO: EXPERIENCE IN THE USE OF DESALINATION FOR WATER SUPPLY,
Water Quality Control Div., National Drinking Water Office, BP Rabat-Chellah, Rabat, Morocco.

Group 3A—Saline Water Conversion

H. Abouzaid.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 430-432, 1 tab.

Descriptors: *Desalination, *Morocco, *Electrodialysis, *Reverse osmosis, *Vapor compression distillation, Developing countries, Distillation, Membrane processes, Water distribution, Water transport, Water costs, Operating costs, Cost analysis, Demineralization.

In the arid country of Morocco, freshwater demand often exceeds available water resources. To meet the demand for freshwater, the government installed an electrodialysis plant for treating brackish water at Tarfaya in 1963. Several other desalination plants are in operation using electrodialysis, reverse osmosis, and mechanical and thermal vapor compression. Many localities are supplied occasionally by desalted water from mobile units. Because of the great expense of desalination, to avoid desalination wherever possible or limit its use a double distribution system is used. Brackish water is distributed in the system for all domestic needs other than drinking and cooking, and desalted water is distributed via standpipes to ensure that 15 to 20% of the total water supply is of potable quality. The dual system has been used at Laayoun, and is now under implementation in Tarfaya, Boujdour and Smara. The costs of the dual system are enumerated. In April 1985, the total operating costs were $US 0.64/cu m for brackish-water desalination and $US 2.23/cu m for seawater desalination. A master plan is proposed for all pre-saharian and saharian parts of the country. Under the plan the following four different methods of supplying water are being considered: local development of water resources through an extensive program of groundwater exploration; transportation of water from the north to the south by a long-range feeder network; desalting of locally-available brackish and seawater; and transportation of water by tankers from the northern part of the country. (See also W88-07850) (Geiger-PTT)
W88-07884

SAUDI ARABIA: TWENTY YEARS OF DESALINATION,
Saline Water Conversion Corp., Eastern Province, P.O. Box 752, Al-Khobar 31952 (Saudi Arabia).
D. S. Khumayyis.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 433-435.

Descriptors: *Desalination, *Saudi Arabia, *Water supply development, *Multistage flash distillation, *Distillation, Developing countries, Maintenance, Drinking water, Project planning, Labor, Training, Corrosion, Process control, Brines.

Saudi Arabia depends heavily upon desalination of brackish and sea water for freshwater supplies. In 1974 the Saline Water Conversion Corporation (SWCC) was founded by Royal Decree to build, operate and maintain desalination plants to provide an adequate and reliable water source. At first two small single purpose multistage flash distillation plants were built on the Red Sea. In 1970, a dual purpose facility with a multi-stage flash desalter connected to a power generation plant was built. By 1985, 15 plants on the Red Sea and 4 on the Gulf were in operation. SWCC expanded to include service not only to coastal locations, but also to inland sites. SWCC qualified Saudi engineers are now taking a more important and involved role in the operation and maintenance of the plants. The number of Saudis working in desalination plants is continually rising due to the availability of graduates from the two SWCC training centers. To lessen problems of corrosion and poor design parameters the following were suggested: more attention should be given to material selection; external deaerators should be used to limit dissolved oxygen levels; chemical additives should be used for scale treatment; ball cleaning must be used to increase the running period before acid cleaning when on-line additives are used; and during both the design and the plant operation stages, strict control on allowable minimum brine recycle pressure is needed to restrict boiling of the recycle feed in the brine heater tubes. (See also W88-07850) (Geiger-PTT)
W88-07885

SOMALI DEMOCRATIC REPUBLIC: SOLAR DESALINATION EXPERIENCE,
Kudha Seawater Desalination Project, Mogadishu (Somali Democratic Republic).
A. I. Aden.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 436-440, 2 fig.

Descriptors: *Desalination, *Somali Democratic Republic, *Solar distillation, *Water supply development, *Distillation, Solar energy, Developing countries, Corrosion, Maintenance, Pilot plants, Biomass, Saline water intrusion.

High evaporation rates in the Somali Democratic Republic are responsible for saline water conditions in many groundwater supplies. To alleviate the problems associated with high costs of imported oil, the government of Somali embarked on research into low-cost renewable energies such as solar, wind and biomass. The United Nations Childrens Fund and the United Nations Industrial Development Organization helped design and build the Kudha solar desalination plant. The pilot plant consists of 15 blocks of 9 solar still units each. Three storage tanks store raw seawater, rain water and distilled water, and the water supply for the village, respectively. Deficiencies associated with plant operation include poor reliablity, an inadequate labor force, and corrosion and maintenance problems. The 3,600 sq m plant serves a village population of about 2,000 people. (See also W88-07850) (Geiger-PTT)
W88-07886

3B. Water Yield Improvement

REMOTE AND IN SITU OBSERVATIONS OF SIERRA NEVADA WINTER MOUNTAIN CLOUDS: RELATIONSHIPS BETWEEN MESOSCALE STRUCTURE, PRECIPITATION AND LIQUID WATER,
U.S. Bureau of Reclamation, Auburn, California.
For primary bibliographic entry see Field 2B.
W88-07691

STATISTICAL STUDY OF THE NORTH DAKOTA CLOUD MODIFICATION PROJECT,
Oklahoma Univ., Norman. Oklahoma Climatological Survey.
H. L. Johnson, and M. P. Foster.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227336. Price codes: A04 in paper copy, A01 in microfiche. Operational Weather Modification, Volume 14, February 1985. 57 p, 9 fig, 44 tab, 17 ref, append.

Descriptors: *Weather modification, *Statistical studies, *Cloud seeding, *North Dakota, *Data interpretation, Analysis of variance, Radar, Rain gages, Model studies, Statistical analysis, Convection.

An analysis of covariance has been applied to radar and raingage data collected in support of the North Dakota Cloud Modification Project. Rawinsonde observations and a one-dimensional cloud model were used to provide covariates. The cloud model provided useful covariates information for all response variables tested. Analysis indicates that several radar measured response variables and area averaged raingage observations are suitable for analysis by this technique and should be considered for use in any formal evaluation effort. Local area rawinsondes taken prior to the onset of convection generally were more useful in the analysis than those taken routinely in the synoptic network. (Author's abstract)
W88-07741

OVERVIEW OF NON-CONVENTIONAL WATER RESOURCES IN DEVELOPING COUNTRIES,
United Nations, New York. Dept. of International Economic and Social Affairs.
For primary bibliographic entry see Field 3A.
W88-07851

CLOUD SEEDING - A SOURCE OF WATER,
World Meteorological Organization, Geneva (Switzerland).
L. R. Koenig.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 260-279, 3 fig, 1 tab, 5 ref.

Descriptors: *Cloud seeding, *Weather modification, *Water supply development, *Cost analysis, *Developing countries, Economic aspects, Artificial rainfall, Capital costs, Operating costs, Environmental effects, Evaluation, Cost-benefit analysis.

The current status of precipitation enhancement and its role as a possible source for water in developing countries are reviewed. Some advantages and disadvantages of cloud seeding operations are listed. Cloud seeding may be performed routinely to obtain precipitation or be used in times of drought conditions. Trends on worldwide precipitation enhancement activities are presented graphically for the years 1975 through 1983. A precipitation enhancement project is made up of a survey of the target site, an evaluation of project benefits, and establishment of project requirements (headquarters office, rain-gage network, seeding agent generators, aircraft, radar, pilot balloons and radio sondes, and manpower). Capital and preliminary costs of a well designed project will by approximately $1,300,000. Cost-benefit analyses of such projects are extremely difficult to make. A large estimated benefit/cost ratio should be secured before proceeding with cloud seeding projects. With respect to the efficacy of cloud seeding, the procedure can increase precipitation, make no changes in precipitation or decrease precipitation. The environmental effects of cloud seeding are minimal; however, social, political and legal aspects of weather modification should be considered before any large-scale project is undertaken. Sources for obtaining information on weather modification are listed. (See also W88-07850) (Geiger-PTT)
W88-07866

CONCEPTUAL EVALUATION OF 'STATIC' AND 'DYNAMIC' SEEDING MODES BASED ON RECENT ANALYSES OF ISRAELI II AND FACE 2 EXPERIMENTS,
A. Gagin.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 280-306, 5 fig, 8 tab, 22 ref.

Descriptors: *Cloud seeding *Weather modification, *Artificial rainfall, *Evaluation, *Statistical analysis, Regression analysis, Silver iodide, Clouds, Cloud physics, Rainfall intensity, Radar, Feasibility studies.

The validity of some of the basic hypotheses underlying the techniques of cloud seeding aimed at increasing rainfall by either producing microphysical 'static' effects in the treated clouds, or by triggering 'dynamic' changes in them is conceptually evaluated using data obtained in the Israeli II and Florida Area Cumulus (FACE-2) experiments. Results confirmed that the Israeli II project, using 'static' mode seeding will enhance rainfall either by making the already existing rain mechanisms more effective or by the initiation of rain in clouds that otherwise would not have precipitated. Silver iodide (AgI) seeding in FACE-2, using the 'dynamic' mode, affected the properties of the treated convective cells and the resulting total rainfalls. These properties were predicted from the changes

in cell height following seeding. The effect of seeding appears to be strongest for cells treated early in their life cycle with a substantial amount of AgI (>600 g). Seeding effects of a 20% increases in cell height and > 100% increase in cell rain volume are indicated. These effets are probably associated with a parallel suppressive effect on adjacent clouds as a result of dynamic compensating processes resulting from the enhanced growth of the treated convective cells. Direct experimental evidence now confirms the basic tenet of the technique of rainfall enhancement by cloud seeding for 'dynamic' effects. This evidence substantiates the hypotheses that if seeding could increase cloud depth, then the corresponding properties of the deeper clouds, namely their intensity, area and duration of rainfall, will be such that they will precipitate larger total rain volumes. The components contributing to the total rainfall volume precipitated by convective rain cells, have a dependence on cloud depth in a manner that can be described by a set of power laws. The combined effect of the dependence of these convective rain cell properties on cloud depth is also manifested in a power law relationship which relates a ten-fold increase in total rain volume to a two-fold change in cloud depth. (See also W88-07850) (Geiger-PTT)
W88-07867

RAIN-WATER HARVESTING: AN OVERVIEW,
Small Caribbean Islands Water Assessment, Development and Management Project, United Nations Department of Technical Cooperation for Development.
P. Hadwen.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 307-313, 7 ref.

Descriptors: *Water harvesting, *Water supply development, *Water storage, *Catchment areas, *Runoff, Water tanks, Rainfall intensity, Impervious beds, Potable water, Drinking water, Storage tanks, Public health.

Rain-water harvesting works on the principle of intercepting rain as it falls, and then storing it for beneficial use. Preparation of a suitable collection surface, such as a roof or other impervious surface, and channelling the flow is relatively easy and inexpensive. Construction of low cost reservoirs has presented the greatest challenge. Improvements in this aspect of rain-water harvesting have been taken in the last five to seven years. Water storage tanks of concrete, concrete lined with bamboo, galvanized iron tanks, and ferro-cement tanks have been highly successful. In the last decade many low-cost appropriate technology studies have been carried out (gravity supplies, handpumps, shallow wells, sand dams, and the use of solar and biogas energy sources). Problems of remoteness of villages or islands, difficulty of obtaining fuel or other supplies, provision of maintenance, high cost and reliability are problems common to most water supply systems. If an improved village water supply system breaks down, people resort to traditional sources, such as ponds, water holes, springs, and rivers, which are often polluted. Thus, any health benefits resulting from improved supplies are often lost during such breakdown periods. Rain-water collection probably has the most potential for improving water supplies at the level of satisfying basic human needs. In most countries, the full potential of rain-water harvesting is not being exploited. In the efforts to meet the ambitious goals of the International Drinking Water Supply and Sanitation Decade, a highly significant role can be played by rain-water harvesting methods. (See also W88-07850) (Geiger-PTT)
W88-07868

CAYMAN ISLANDS: COUNTRY SITUATION REPORT,
The Water Authority, P.O. Box 1104, Grand Cayman.
For primary bibliographic entry see Field 3A.
W88-07873

CHINA: THE DEVELOPMENT AND USE OF NON-CONVENTIONAL WATER RESOURCES,
Bureau of Municipal Engineering and Public Utilities, Ministry of Urban and Rural Construction and Environmental Protection, Baiwanzhuang, Beijing, People's Republic of China.
For primary bibliographic entry see Field 3C.
W88-07874

INDONESIA: THE USE OF NON-CONVENTIONAL WATER RESOURCES,
Water Quality and Environmental Div., Inst. of Hydraulic Engineering, Ministry of Public Works, Jakarta (Indonesia).
For primary bibliographic entry see Field 3C.
W88-07877

TURKS AND CAICOS ISLANDS: BRIEF NOTES ON WATER SUPPLIES,
Ministry of Works and Utilities, Nassau (The Bahamas).
For primary bibliographic entry see Field 3A.
W88-07878

CARIBBEAN ISLANDS: A REVIEW OF ROOF AND PURPOSE BUILT CATCHMENTS,
Small Caribbean Islands Water Assessment, Development and Management Project, United Nations Dept. of Technical Cooperation for Development.
P. Hadwen.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 455-468, 21 ref.

Descriptors: *Water harvesting, *Water supply development, *Caribbean Islands, *Drinking water, *Water storage, Cisterns, Water tanks, Developing countries, Catchment areas, Potable water, Urban runoff, Desalination, Groundwater mining, Water transport.

For more than three centuries, roof catchments and cistern storage have been the basis for a domestic water supply in many small islands of the Caribbean. Urban runoff has been collected for agricultural use and many large factories use roof catchments for collecting water for industrial purposes. A formula has been devised for estimating the optimal cistern size required for public supplies. The majority of roof catchment systems are of galvanized iron, both painted and unpainted. In Bermuda, specially cut and painted limestone has been used for years. Concrete is the main material used to create purpose built impervious surfaces. A review of water catchment systems in several Caribbean countries is given. Countries discussed include: Anguilla, Antigua, the Bahamas, Barbados, Barbuda, Belize, Bermuda, the British Virgin Islands, the Cayman Islands, Dominica, Grenada, Guadaloupe, Honduras, Jamaica, Martinique, Montserrat, the Netherlands Antilles, St. Kitts/Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, the Turks and Caicos Islands, the United States Virgin Islands, and the Venezuelan group of islands. (See also W88-07850) (Geiger-PTT)
W88-07890

KENYA AND BOTSWANA: EXPERIENCE WITH RAIN-WATER CATCHMENT SYSTEMS,
Alberta Univ., Edmonton. Dept. of Geography.
H. J. McPherson, and J. Gould.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 469-487, 7 fig, 1 tab, 26 ref.

Descriptors: *Water harvesting, *Kenya, *Botswana, *Developing countries, *Water supply development, Catchment areas, Impervious beds, Rocks, Water storage, Storage tanks, Water tanks, Water demand, Water supply, Comparison studies, Cost analysis.

Experiences with rain water catchment in Kenya and Botswana is described, along with the current technology, the costs of the various alternative systems, and the major advantages and disadvantages identified with rain water catchments in East Africa. Three main types of rain water catchment systems are roof catchments, rock catchments, and groundwater catchments. Calculating the available supply and the size of the storage tank needed to meet the estimated demand is perhaps the most critical step in designing a catchment system. Computer modelling provides a reliable method for estimating an appropriate storage tank size for any given climatic situation at whatever level of reliability is desired. Reservoirs for rock catchments normally consist of a dam wall behind which an open reservoir stores the rain water. In ground catchments, due to the fact that the catchment apron is at ground level, the storage reservoir always consists of a sub-surface tank. Roof catchment systems have the option of purchasing a ready-made factory built tank which is usually of corrugated iron. Other tanks that may be used with roof catchments are cement jar tanks, Ghala basket tanks, concrete ring tanks, and ferro-cement tanks. A cost comparison of different types of roof catchment tanks in Kenya and Botswana is given. In both Kenya and Botswana rain water catchment has been applied mainly in the arid and semi-arid areas where there is an urgent need for water, and surface water and groundwater are either scarce or non-existent. Main problems with storage tanks are that the tanks are too small, they leak or do not hold water, or are improperly covered. The advantages of rain water catchment are: the good quality of the water supply; availablility of water at the point of use (the home); the ownership of the supply system by the householder; low operation and maintenance costs; and ease of repairs (all spare parts were obtained locally). The main disadvantages of rain water catchment are the expensive initial capital outlay for a storage tank, and, with rock and ground catchment schemes, water may require some form of treatment before it can be safely used. (See also W88-07850) (Geiger-PTT)
W88-07891

THAILAND: RAIN-WATER TANK PROJECT OF THE POPULATION AND COMMUNITY DEVELOPMENT ASSOCIATION,
Water Resources Unit, Population and Community Development Assn., Sukhumvit Soi 12, Bangkok (Thailand).
P. Sornjitti.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 488-503, 8 tab, 9 ref, append.

Descriptors: *Water harvesting, *Thailand, *Water supply development, *Rural areas, *Drinking water, Public health, Water tanks, Water storage, Storage tanks, Water resources development, Financing, Cost analysis, Maintenance.

Problems of poverty in the northeast sector of Thailand are compounded by the inadequate rainfall and dryness of the region. In cooperation with the United Nations International Drinking Water Supply and Sanitation Decade, the government of Thailand set up the Fifth Five Year Plan to help those poverty areas where drinking water was in shortest supply. The plan promoted the use of appropriate technologies, and extended the opportunities for people to help themselves by establishing co-operative groups and revolving funds. The plan also mobilized the joint efforts of the government and non-governmental organizations such as the Population and Community Development Association (PDA). In 1978, PDA began its own water resources development program as a supplement to the activities of the Government, with the promotion of shallow wells and latrines. In 1980, these activities were expanded to include rain water catchment in village ponds, bored and dug wells, hand pumps and rain water tanks. A PDA pilot project in which 53 tanks were built evaluated community participation in tank construction and tested tanks of varying capacity utilizing three different types of construction: ferro-cement, bamboo-reinforced concrete and cement rings. PDA provided tools and equipment for the tanks while the villagers provided labor. The success of

the pilot project led PDA to continue its efforts in water resources development with Rain Water Tank Projects (Tungnam I, II, III and IV). These projects provided a source of sanitary drinking water for rural families of northeast Thailand, developed a community-based system for the delivery of that service, promoted village-level co-operation in development activities, and created an administrative system for the revolving fund mechanism to spur village development activities without external financing. (See also W88-07850) (Geiger-PTT)
W88-07892

EGYPT: REUSE OF DRAINAGE WATER IN IRRIGATION,
Drainage Research Inst., Water Resources Centre, Ministry of Irrigation, Cairo (Egypt).
S. El-Gindy.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 504-510, 3 tab, 4 ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Egypt, *Drainage water, Water quality, Subsurface drainage, Water management, Crop production, Recycling, Cost analysis.

The Ministry of Irrigation of Egypt and the Ministry of Foreign Affairs of the Netherlands jointly funded a 'Reuse of Drainage Water Project' to assess the quantity and quality of drainage water not being used for irrigation. The project also attempted to predict the time trends of the parameters influenced by subsurface drainage, to estimate increases in cropping intensity and improved water management, to monitor the change in these parameters over time, to collect data to produce an overall water and salt balance for the Nile Delta, to indicate where and how drainage water can be reused, and to evaluate the effect of reuse of drainage water on crop production. Discharge measurements at predetermined sections along the main drains were carried out every two weeks by the velocity-area method. The total amount of drainage water reused for irrigation in Egypt was estimated at 2,615,000 cu m. The over-all salinity average of the drainage water was quite high (between 1,300-1,500 ppm). Using results for the 'Reuse of Drainage Water Project', three reuse projects are now under construction to reclaim about 760,000 feddans (317,000 ha) of land in the Nile Delta and El-Fayoum areas, reusing irrigation drainage water mixed in various proportions with Nile River water. Total expected costs of these three projects are discussed. (See also W88-07850) (Geiger-PTT)
W88-07893

JAMAICA: RAIN STIMULATION PROGRAMME FOR THE KINGSTON AND ST. ANDREW WATER COMMISSION, 1975 TO 1977,
National Water Commission, Kingston (Jamaica).
N. Gauntlett.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 511-512.

Descriptors: *Weather modification, *Cloud seeding, *Jamaica, *Artificial precipitation, *Simulated rainfall, Artificial storms, Aircraft, Developing countries, Water supply development, Water demand.

The Water Commission of Jamaica initiated a rain stimulation program in April 1975 by engaging the firm of North American Weather Consultants from Denver, Colorado. The firm carried out a cloud seeding program, in co-operation with the Meteorological Office and the Air Wing of the Jamaica Defense Force (JDF), who provided the airplane and pilot. Cloud seeding opportunities were located and determined by the Meteorological Office's Weather Radar at Cooper's Hill, and the information was then telephoned to the Air Wing of the JDF where plane, pilot, and representatives of the Meteorological Office and of the North American Weather Consultants were standing by ready for action. During the low rainfall seasons of 1976 and 1977, the seeding program was again initiated without the help of the North American Weather Consultants. A number of showers resulted from seeding activities although their effect was not as noticeable as it had been in the first seeding program. Although a National Cloud Seeding Program was proposed, this had to be abandoned when the plane crashed and was damaged beyond repair. Another factor that sometimes affected utilization of seeding opportunities was the availability of oxygen. Since the plane was not pressurized, oxygen masks had to be worn by the pilot, and oxygen tanks were not always available. Rainfall records of the first program revealed increased rainfall and streamflow in the target area. Another side-effect of cloud seeding operations was the reduction in water demand on the days when rain fell in the distribution area, thereby reducing the draw-off on the system of water for gardens. It is recommended that the cloud seeding program be continued and extended island-wide, and that proper equipment be made available for its success. (See also W88-07850) (Geiger-PTT)
W88-07894

3C. Use Of Water Of Impaired Quality

EFFECT OF SALINITY ON LEAF IONIC CONTENT AND PHOTOSYNTHESIS OF TAXODIUM DISTICHUM L.,
Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.
For primary bibliographic entry see Field 2H.
W88-06838

ANIMAL VIRUSES, COLIPHAGES, AND BACTERIA IN AEROSOLS AND WASTEWATER AT A SPRAY IRRIGATION SITE,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-07008

MANAGING SALINITY THROUGH CONJUNCTIVE USE OF WATER RESOURCES,
Central Soil Salinity Research Inst., Karnal (India). Div. of Agricultural Engineering.
N. K. Tyagi.
Ecological Modelling ECMODT, Vol. 40, No. 1, p 11-24, January 1988. 5 fig, 6 tab, 13 ref.

Descriptors: *Saline water, *Saline soils, *Conjunctive use, *Water resources development, *Mathematical models, Groundwater, Soil water, Surface water, Irrigation, Imported water, Arid lands, Semiarid lands, Waterlogging, Land reclamation, Water allocation, Salt balance, Root zone, Groundwater budget, Pumping, Drainage, Available water, Cropland, Decision making, Planning, Systems analysis, Linear programming, Land use, Water allocation, Hydrologic budget, Aeration zone, Saturation zone, Groundwater potential, Crop production, Drainage effects, India.

Planned development and use of saline groundwater in conjunction with limited fresh water supplies is essential in arid and semi-arid regions for reclamation and management of waterlogged saline lands. A decision model based on a linear programming algorithm is formulated to aid in planning the optimal use of imported surface water and the saline groundwater. The system operates under a number of constraints, which include water allocation, salt balance in the root zone, groundwater balance, salt balance in the groundwater, groundwater pumped for drainage, water availability, and total land area and the area under crops. The model is applied to a typical waterlogged saline area in the command of Western Yamuna Canal in Haryana (India) to determine optimal land and water allocation and the resulting salt and water balance in the unsaturated and saturated zone. Application of the model indicates that: (1) development of groundwater up to 6 dS/m salinity for irrigation will not only generate additional water resources but will also release additional areas for cultivation by amelioration of waterlogging conditions; (2) increased availability of land and water at higher levels of groundwater development will substantially increase farm production; and (3) drainage and disposal of groundwater with a salinity of more than 8 dS/m is not likely to cause water quality problems in the river Yamuna at Delhi if drainage pumping is scheduled for the July to September rainy season. (Shidler-PTT)
W88-07162

UNSUITABILITY OF WORLD HEALTH ORGANISATION GUIDELINES FOR FLUORIDE CONCENTRATIONS IN DRINKING WATER IN SENEGAL,
Department of Human Nutrition, Agricultural University, Wageningen, The Netherlands.
I. D. Brouwer, O. B. Dirks, A. De Bruin, and J. G. A. J. Hautvast.
The Lancet LANAA1, Vol. 1, No. 8579, p 223-225, January 1988. 4 tab, 11 ref.

Descriptors: *Human diseases, *Epidemiology, *Potable water, *Drinking water, *Water pollution effects, *Toxicity, *Fluorides, *Arid climates, Chemical properties, World Health Organization, Regulations, Senegal, Temperature.

A survey was done of the prevalence of dental fluorosis among children aged 7-16 years and the occurrence of skeletal fluorosis among adults aged 40-60 years living in regions in Senegal where fluoride concentrations in the drinking water ranged from <0.1 to 7.4 mg/l. In the area where the flouride concentration in the drinking water was 1.1 mg/l milder forms of dental fluorosis were found, the prevalence being 68.5%. In areas where fluoride concentrations exceeded 4 mg/l the prevalence of dental fluorosis reached 100%. Kyphosis was very prevalent among a community whose drinking water contained 7.4 mg/l fluoride. Radiographs of the vertebral column, hand, and wrist of 3 adults with kyphosis confirmed the diagnosis of skeletal fluorosis. High sweat loss and a high intake of water because of the hot weather may account for the finding. The present World Health Organization guideline for the upper limit of fluoride concentration in drinking water may be unsuitable for countries with a hot, dry climate. (Author's abstract).
W88-07213

BIOECONOMIC CONSIDERATIONS FOR WASTEWATER REUSE IN AGRICULTURAL PRODUCTION,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
P. N. Wilson, T. J. Goldammer, and J. C. Wade.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 1-9, February 1988. 2 fig, 2 tab, 38 ref.

Descriptors: *Wastewater irrigation, *Decision making, *Water reuse, *Effluents, *Economics, *Wastewater renovation, *Municipal wastewater, *Irrigation, Agriculture, Fertilization, Nutrients, Pricing, Water delivery, Water demand, Arid lands, Arizona.

Urban wastewater can be a valuable source of water and plant nutrients for agricultural producers, particularly in arid regions. The scientific literature reveals cautious optimism concerning the biological, institutional, and economic viability of irrigating crops with secondary-treated effluent. A derived effluent demand function for agricultural producers near Tucson, Arizona, reveals a potential annual demand of 11,000 acre-feet under present price and proposed delivery system conditions. In this case, wastewater could be exchanged for ground water and both the urban and rural areas would gain. However, immediate obstacles to water transfers include the desire by farmers to receive 'inexpensive' effluent over a short period of time, the preference of water resource decision-makers for construction of pipelines, aqueducts and recharge projects, and the competition between urban water authorities and agricultural interests for a scarce resource. (Author's abstract)
W88-07271

CA-CHLORIDE BRINES AT COMMON OUTLETS OF THE BET SHEAN-HAROD MULTIPLE-AQUIFER SYSTEM, ISRAEL,
Research Division, Hydrological Service of Israel, P.O. Box 6381, Jerusalem 91063 (Israel).
For primary bibliographic entry see Field 2F.
W88-07300

INITIAL EVALUATION OF AL SUMRA WASTE STABILISATION PONDS (JORDAN),
The Water Authority of Jordan, Amman.
For primary bibliographic entry see Field 5D.
W88-07320

IRRIGATION REUSE OF POND EFFLUENTS IN DEVELOPING COUNTRIES,
Applied Research and Technology Unit, Water Supply and Urban Development Department, The World Bank, 1818 H St., N.W., Washington, D.C. 20433.
For primary bibliographic entry see Field 5D.
W88-07356

REUSE OF STABILIZATION POND EFFLUENT FOR AGRICULTURAL IRRIGATION IN ISRAEL,
Environmental Engineering and Water Resources Research Center, Technion, Israel Institute of Technology, Haifa 32000, Israel.
For primary bibliographic entry see Field 5D.
W88-07357

REUSE OF STABILIZATION POND EFFLUENT FOR CITRUS RETICULATA (ORANGE), FOREST AND ROAD VERGE PLANTS,
National Environmental Engineering Research Inst., Nagpur (India).
C. K. Kale, and A. S. Bal.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 307-315, 1987. 1 fig, 6 tab, 8 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Stabilization ponds, *Ponds, *Irrigation water, *Biological wastewater treatment, *Ornamentals, *Wastewater irrigation, Evapotranspiration, Wastewater renovation, Orange trees, Trees, Forests, Stabilization lagoons, Plant growth, Orchards, Irrigation engineering, Israel, Land application.

Stabilization pond effluent was used for irrigation of orange, forest plants, roadside vegetation, and an ornamental garden. When compared with well waters used for irrigation in the region, the effluent was comparable or better, containing nutrients, algae, organic matter, and trace metals which were deficient in the well water. Leaves on effluent-watered orange plants had similar osmotic concentration but higher succulence than well water-irrigated plants. Effluent-watered plants also had higher potassium, lower sodium, and the same calcium concentrations as compared with plants irrigated with well water. Among the forest and verge plants many responded well to effluent irrigation, beautifying otherwise neglected areas. These species included Cassia siamia, Peltophorum inerme, Enterolobium saman, Casuarina equisetifolia, Eucalyptus citrodora, Lagerstroemia speciosa, Terminalia catappa, and Leucaena glauca. (Cassar-PTT)
W88-07358

CLOGGING IN IRRIGATION SYSTEMS REUSING POND EFFLUENTS AND ITS PREVENTION,
Human Environmental Sciences Division, School of Applied Science and Technology, The Hebrew University of Jerusalem, Jerusalem, Israel.
A. Adin.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 323-328, 1987. 4 fig, 4 ref.

Descriptors: *Clogging, *Wastewater irrigation, *Filtration, *Water reuse, *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Tertiary wastewater treatment, Oxidation ponds, Wastewater irrigation, Wastewater renovation, Stabilization lagoons, Drip irrigation.

Clogging of emitters, orifices or laterals of drip irrigation systems has been a major obstacle for low rate applicators in wastewater irrigation. Granular filtration and screen filtration were compared for particulate removal in pilot experiments. The removal ratio of particles larger than 10 microns in direct granular filtration was relatively large while smaller particles showed little removal. Particles in the 10-60 micron size range were removed by 40-50% in depth and by 80% when surface filtration prevailed. Screen filters removed only 1-2% of the material and became clogged after a half hour. In addition, particles were released from the screen so that greater clogging occurred down the irrigation line than if screen filtration had not been used. The deep-bed granular coarse media filter was more suitable for use with the renovated water. (Cassar-PTT)
W88-07360

CHARACTERIZATION OF SALINE GROUNDWATER RESOURCE QUALITY FOR AQUATIC BIOMASS PRODUCTION: A STATISTICALLY-BASED APPROACH,
Solar Fuels Division, Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401.
W. R. Barclay, N. J. Nagle, K. L. Terry, S. B. Ellingson, and M. R. Sommerfeld.
Water Research WATRAG, Vol. 22, No. 3, p 373-379, March 1988. 5 fig, 5 tab, 35 ref.

Descriptors: *Water conservation, *Impaired water use, *Geochemistry, *Aquaculture, *Saline water, *Groundwater, *Algae, Water quality, Biomass, New Mexico, Chemical composition.

A study was conducted to determine if the saline groundwaters of New Mexico could be statistically reduced to a few major types based on ionic composition. A decreased number of water types could then be used to screen candidate microalgal strains for tolerance to various environmental conditions and for biomass production potential. Two major water types were identified, both with average salinities of 4000 mg/liter total dissolved solids. Type I water had a much higher divalent ion concentration than Type II water and was dominated by Na+, Cl-, Mg++, and Ca++. The major ions in Type II water were Na+, Cl-, sulfate, and bicarbonate. The relative ionic composition of the two water types that were derived from the analysis of saline groundwater were also representative of the ionic composition of the saline surface waters of the southwestern U.S. The growth rates of several microalgal strains were measured in the two water types over a range of temperatures (10-35 C) and conductivities (10-70 mmho/cm). The algae exhibited a wide range of growth responses to the water types indicating the importance of screening the strains with waters which would be available for biomass production. (Author's abstract)
W88-07550

POTENTIAL USE OF THE DEEP AQUIFERS IN THE NEGEV DESERT, ISRAEL - A CONCEPTUAL MODEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
R. Nativ, Y. Bachmat, and A. Issar.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 237-265, October 30, 1987. 13 fig, 2 tab, 11 ref.

Descriptors: *Aquifers, *Irrigation, *Impaired water use, *Brines, *Industrial water, *Underground waste disposal, *Waste disposal, *Rocks, *Model studies, Mathematical analysis, Regression analysis, Geohydrology, Brackish water, Saline water, Negev Desert, Israel.

The deep aquifers (Jurassic-Paleozoic, 1-5 km deep) underlying the Negev Desert, Israel, contain brackish to saline water (800-120,000 ppm Cl(-)) and have been penetrated by only 47 wildcat oil drillings. The objective of this study was to evaluate the water potential of these aquifers for irrigation and for industrial consumption as well as their potential for serving as host rocks for hazardous wastes. A methodology was developed for constructing a conceptual model for the thick sequence of layers in which these aquifers are found. It seems that, although these aquifers have different lithologies, they may be hydraulically connected. Statistics of the distribution of the aquifer system's parameters of state and analysis of their variance are used to aggregate individual formations into a few large hydrologic units. Regression analysis was used to supplement missing data and to evaluate estimation errors. Based on this methodology, a model consisting of three aquifers was defined. The consistency of the conclusions of the model was confirmed by studies of pressure, permeability, salinity, temperature, and isotopic distribution. Wherever data were scarce, hydraulic parameters were estimated by linear regression. According to the study, the lower aquifer in the northern Negev contains only brines and is hydrologically separated from the two aquifers above it. The lower aquifer could, therefore, be considered as a possible site for toxic waste disposal or, at suitable locations, for hydrocarbon exploration. Hydrological continuity probably exists between the upper and middle aquifers in the eastern and central Negev, where brackish water is found in both aquifers. The methodology used here is suitable for constructing a conceptual model of any complex geohydrologic system in an area with scarce data. (Author's abstract)
W88-07580

GENOTYPIC RESPONSE TO SODIUM CHLORIDE SALINITY OF FOUR MAJOR OLIVE CULTIVARS (OLEO EUROPEA L.),
Dept. of Horticulture, Faculty of Agriculture, Aristotelian Univ., Thessaloniki, Greece.
I. N. Therios, and N. D. Misopolinos.
Plant and Soil PLSOA2, Vol. 106, No. 1, p 105-111, February 1988. 4 fig, 1 tab, 29 ref.

Descriptors: *Impaired water use, *Water pollution effects, *Salt tolerance, *Olive trees, *Food crops, *Salinity, *Plant growth, Toxicity, Crop yield, Roots, Plants, Plant pathology, Water use.

The relative tolerance to NaCl of the olive cultivars 'Amphissis', 'Chondrolia Chalkidikis', 'Koroneiki' and 'Megaritiki' was studied in a nutrient-solution pot experiment. Three-year-old plants produced from cuttings were transplanted to sand-perlite (1/1) culture and irrigated with 1/2 strength Hoagland solution containing NaCl at various levels, i.e. 0, 15, 30, 45, 60 and 80 meq/L in the first and 0, 30, 60, 90, 120 and 150 meq/L in the second experiment. The overall results indicate that NaCl application had a definite growth-reducing effect under the conditions of the experiment, but to a different extent in each cultivar. Salinity decreased dry weight of leaves in all cultivars, dry weight of stems in 'Chondrolia Chalkidikis'. Also the top/root ratio was reduced by NaCl in 'Chondrolia Chalkidikis' and 'Megaritiki'. Stem elongation was reduced by salinity in 'Chondrolia Chalkidikis' and 'Koroneiki', but was unaffected in 'Amphissis' and 'Megaritiki' by salinity of between 0-80 meq/L NaCl. On the basis of toxicity symptoms and other measured parameters of growth, 'Chrondrolia Chalkidikis' seems to be more sensitive to NaCl than the other 3 cultivars. Salinity up to 80 meq/L NaCl increased the percentage of perfect flowers in 'Chrondrolia Chalkidikis' and decreased it in 'Megaritiki'. Salinity also significantly reduced water absorption. (Author's abstract)
W88-07636

USE OF WATER CONDITIONERS IN WATER-RECIRCULATION SYSTEMS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
D. C. LaBomascus, E. H. Robinson, and T. L. Linton.
The Progressive Fish-Culturist PFCUAY, Vol. 49, No. 1, p 64-65, January, 1987. 1 tab.

Descriptors: *Water conditioning, *Recirculated water, *Fish hatcheries, *Biofilters, *Nitrification, *Bacteria, *Nitrogen removal, Filters, Biofiltration, Filtration, Oxidation, Oxygen, Dissolved oxygen, Saline water, Ammonia, Performance evaluation, Nitrites, Temperature, Hydrogen ion concentration, Fish.

Commercial water conditioners containing concentrated solutions of Nitrosomonas and Nitrobacter spp. were evaluated for their effectiveness in activating nitrifying biofilters in hatchery water-reconditioning systems containing red drum fingerlings. Conditioners were tested in both fresh- and salt water situations. Low concentrations of ammonia were maintained throughout the test period except for the first days of the second trial. Nitrite concentrations were <1.0 mg/L by day 20. The freshwater conditioner did not immediately nitrify ammonia as did the salt water conditioner. Approximately 4 days were required for the freshwater conditioner to control ammonia, probably because of differences in salinity requirements of the salt and freshwater bacteria. After day 10, daily nitrite concentrations gradually decreased to 0.03 mg/L. Although there were no apparent ill effects on the red drum, nitrite concentrations of the magnitude observed in this trial may be harmful to more susceptible species. (Author's abstract)
W88-07661

EFFECTS OF SALINITY AND GIBBERELLIN ON WATER CONTENT, GROWTH AND MINERAL COMPOSITION OF COWPEA, CALABRESE AND RED RADISH PLANTS,
A. M. Abdel-Rahman.
Biologia Plantarum (Praha) BPABAJ, Vol. 29, No. 5, p 365-373, 1987. 3 tab, 39 ref.

Descriptors: *Salinity, *Gibberellin, *Plant growth, *Vegetable crops, *Impaired water use, *Irrigation effects, *Salt tolerance, *Minerals, *Plant growth substances, Nitrogen, Phosphorus, Potassium, Sodium, Leaves, Plant physiology.

Cowpea, calabrese, and red radish grown in the greenhouse were watered every two days with saline solutions of different concentrations and their leaves sprayed with gibberellin (GA3) at 7-day intervals to determine the effect of saline irrigation on water content, growth, and mineral composition of the plants. It was found that salinity had generally little influence on the water content of different parts of the plants. Salinity showed a promotive effect on the growth of cowpea, while its effect on calabrese and red radish was either promotive or depressive depending on the concentration of NaCl. Salinity progressively suppressed growth of red radish. Salinity did not affect total nitrogen, phosphorus, potassium, and sodium contents of cowpea leaves. In calabrese and red radish leaves, N, P, and K contents generally decreased as salinity increased. Gibberellin applied to salt-treated plants had either a stimulatory or inhibitory effect on growth, water content, and leaf N, P, K, and Na content depending upon plant type, GA3 concentration, and salinity level. (Author's abstract)
W88-07672

PORTABLE WATER PRETREATMENT CUTS DEMINERALIZER LOADING,
Public Service Co. of Indiana, Inc., Plainfield.
For primary bibliographic entry see Field 5F.
W88-07678

NUMERICAL CLASSIFICATION OF SALINE GROUNDWATER CHEMISTRY IN THE MURRUMBIDGEE IRRIGATION AREA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2F.
W88-07699

NON-CONVENTIONAL WATER RESOURCES USE IN DEVELOPING COUNTRIES.
Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28. United Nations, New York. Natural Resources/Water Series No. 22, 1987. 515 p.

Descriptors: *Water resources development, *Desalination, *Wastewater renovation, *Developing countries, *Weather modification, Water transport, Cloud seeding, Catchment basins, Water reuse, Wastewater treatment, Wastewater irrigation, Economic aspects, Public health, Drinking water.

The Interregional Seminar on Non-conventional Water Resources Use in Developing Countries was organized by the United Nations Department of Technical Cooperation for Development, the Government of the Netherlands Antilles and the Island Government of Curacao to discuss the progress achieved over the last 20 years in the fields of desalination, transportation of water by tanker, wastewater reuse, weather modification (cloud seeding) and rain-water harvesting in developing countries. Forty-eight technical papers were submitted relating to the main topics of the seminar. Besides the conclusions of the three working groups of the seminar, areas covered in the report include: an overview of non-conventional water resources in developing countries; desalination; transportation of water by tanker; wastewater reuse; weather modification; rain-water harvesting; experiences with non-conventional water resources; rain-water catchment system. (See W88-07851 thru W88-07894) (Geiger-PTT)
W88-07850

OVERVIEW OF WATER REUSE FOR DEVELOPING COUNTRIES,
American Water Works Association Research Foundation, Denver, CO.
J. DeBoer.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 160-178, 4 fig, 5 tab, 11 ref.

Descriptors: *Water reuse, *Developing countries, *Wastewater treatment, *Wastewater disposal, *Wastewater renovation, Water supply development, Recycling, Water demand, Beneficial use, Aquaculture, Nutrient removal, Oxidation ditches, Public health, Advanced wastewater treatment.

Reuse of municipal wastewater for beneficial purposes has been practiced for many years throughout the world. Several economic, social, legal, and technical factors affect water reuse. As the demand for water increases in developing countries, the demand for a reclaimable wastewater also increases. The technology available for water reuse is a combination of existing wastewater treatment and water supply treatment technologies, with the addition of some industrial treatment technologies. Besides conventional treatment systems for the treatment of wastewater for reuse, aquaculture ponds, wetlands disposal systems, and other land disposal methods are available. Advanced wastewater treatmnt systems offer nutrient removal, and enhanced solids removal. Dual distribution systems, supplying potable water through a primary system, and a lower quality, reclaimed wastewater through a secondary system, have been used at many sites in the United States. Health effect implications of water reuse for potable purposes are being investigated in numerous studies. Health effects are also a concern when reclaimed wastewater is used for non-potable purposes, such as agricultural irrigation, urban irrigation or industrial applications. Some representative treatment process costs for water reuse are presented. (See also W88-07850) (Geiger-PTT)
W88-07861

WASTE-WATER REUSE AND ITS APPLICATIONS IN WESTERN ASIA,
Economic and Social Commission for Western Asia (ESCWA), Baghdad (Iraq). Natural Resources, Science and Technology Div., Water Resources Section.
C. Ertuna.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 179-208, 1 fig, 6 tab, 22 ref.

Descriptors: *Water reuse, *Wastewater renovation, *Western Asia, *Wastewater treatment, *Wastewater disposal, Wastewater irrigation, Land disposal, Wastewater management, Economic aspects, Groundwater recharge, Minimum flow, Recycling, Developing countries.

Wastewater reuse has been in practice in the United Nations Economic and Social Commission for Western Asia (ESCWA) for a considerable period of time; however, it has been limited in application and only recently plans have been formulated for large-scale development of this non-conventional source of water. While the treated effluent is not recommended for potable or domestic purposes, in water-short developing countries it is used in municipal parks, street-cleaning, fire-fighting, industry, agriculture, etc. A survey of new treatment plants that will use municipal wastewater has indicated that 10 mg/l BOD and 10 mg/l TSS are established as minium effluent quality standards in the Gulf countries. If a government decides to use treated wastewater as a source of supply, a policy regarding the use of treated effluent must be established. The following precautions and safeguards are recommended in wastewater reuse, particularly in the ESCWA region: standards should be strictly followed; pipes and other system components carrying freshwater supplies and treated sewage effluent should be clearly differentiated to prevent cross- connections; users of treated wastewater should be informed about handling safety to prevent possible contamination with the treated effluent; industries should be encouraged to recycle part of their wastewaters and treat the rest to acceptable standards; return flows as drainage water to streams should be strictly monitored; in streamflow augmentation the treated effluent must meet established criteria to protect human and animal health; for groundwater recharge and prevention of saline water intrusion to the aquifer, quality of the treated wastewater should be close to drinking water standards; and finally, the precautions to be taken on the reuse of treated effluents must be presented to the public through the media. (See also W88-07850) (Geiger-PTT)
W88-07862

WASTE-WATER REUSE IN INDUSTRY,
Agence Financiere de Bassin Seine-Normandie, Paris (France).
G. Pauthe.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 209-213.

Descriptors: *Water reuse, *Industrial wastewater, *Municipal wastewater, *Industrial water, *Food-processing wastes, *Wastewater renovation, Cooling water, Environmental effects, Economic aspects, Monitoring, Wastewater treatment, Wastewater disposal, Oily water.

The reuse of wastewater when the second use is different from the first is considered. Municipal wastewater is reused in industry as cooling water, for material and solid wastes transport, and material washing. Examples of industrial wastewater reuse within the same plant are given from different industries. In dairy works, water is used for cooling, making steam and washing products or apparatuses. The main possibility for water recycling or reuse in sugar refineries is to use evaporation water for diffusion and washing. In a slaughter house treated wastewater is reused to wash the cow shed. In the fruit industry, fruit juice concentration water is used to transport and wash the fruit and to produce steam. Wastewater from the chemical industry is used as rinse water or as raw material base in the making of fertilizers and paints. Oily water from the oil refinery industry is used for cooling and washing purposes. Some technical, economic and environmental advantages and drawbacks of water reuse are discussed. Water resources reuse allows the saving of top quality water for more essential uses. (See also W88-07850) (Geiger-PTT)
W88-07863

WASTE-WATER REUSE FOR IRRIGATION AND AQUACULTURE,
The World Bank. Applied Research and Technology Unit, Water Supply and Urban Development Dept.
S. Arlosoroff.

IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 214-244, 5 fig.

Descriptors: *Wastewater irrigation, *Water reuse, *Aquaculture, *Irrigation, *Wastewater renovation, *Wastewater management, Institutional constraints, Recycling, Economic aspects, Social aspects, Land reclamation, Waste management, Developing countries.

The Integrated Resource Recovery Project was designed to promote health, economic and financial benefits through resource recovery and utilization projects in developing countries. During the project research phase, international consultants were commissioned to prepare case studies. Global reports on resource recovery from municipal solid wastes, anaerobic digestion, health effects of wastewater irrigation and their control, ultimate disposal of wastewater to the ocean, waste-fed aquaculture and a technical framework for economic analysis of waste recycling and disposal were completed. Information in the case studies was obtained at three levels: engineering surveys of present and potential waste sources, management and recycling systems; a multidisciplinary study of institutions, financing, technologies, utilization, and possible integration of waste recycling activities at sites selected from the original list; and identification, preparation and implementation of demonstrations at 4 to 6 sites. The following initial project conclusions from three years of global research and development have been obtained: integrated recovery and institutionalization of urban solid and liquid wastes management can reduce costs to municipalities by 30 to 50%; economic benefits of recycling are revealed by the employment of 1 to 2% of the urban population in secondary materials enterprises and seasonal irrigation using the sewage from developing country cities; potential environmental and health effects of waste collection and disposal can be economically controlled by appropriate recycling technologies; institutional and social contraints to recycling can be identified and dealt with; and selection of an appropriate resource recovery technology and system is site-specific and depends upon waste quantities and characteristics, environmental and economic policies, scale of industrialization, and the potential demands for recovered resources. (See also W88-07850) (Geiger-PTT)
W88-07864

HEALTH ASPECTS OF WASTE-WATER REUSE FOR IRRIGATION OF CROPS,
Pan American Health Organization (PAHO), Washington, DC. Environmental Health Program.
F. M. Reiff.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 245-259, 1 fig, 7 tab, 5 ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Land disposal, *Developing countries, *Public health, Human diseases, *Wastewater renovation, Viruses, Bacteria, Parasites, Epidemiology, Protozoa, Wastewater treatment, Risks, Economic aspects, Public health, Risks.

Many developing countries are reusing wastewater for irrigation and aquaculture. Municipal sewage contains two broad categories of agents which can have adverse effects on human health: pathogenic microorganisms from fecal and urinary waste of humans and animals; and toxic substances generated and discarded by mankind. Three probable routes of exposure to pathogens exist: direct exposure of workers and nearby residents during transportation or application of the wastewater or contact with sewage amended soil; consumption of the plants grown in the soil, or of animals feeding on these plants; and ingestion or contact with surface or groundwater contaminated respectively by runoff or percolation. Pathogens which may be present in wastewater destined for reuse include: viruses, bacteria, helminths, and protozoa. Chronic non-contagious diseases can be traced to substances in wastewater such as nitrogen, heavy metals, pesticides, and organic compounds. Several methods are available to reduce the risks to human health. These include: medical interventions (immunization); prohibition and restriction of crops; restriction of irrigation methods; improved worker hygiene; disinfection and cleaning of crops; and improved sewage treatment. Economic, social and institutional conditions in developing countries using wastewater irrigation require a risk-benefit approach in the selection of methods of wastewater treatment. (See also W88-07850) (Geiger-PTT)
W88-07865

DUAL WATER SYSTEMS IN THE UNITED STATES VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
H. H. Smith.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 321-325, 6 ref.

Descriptors: *Water reuse, *Desalination, *Saline water intrusion, *Virgin Islands, Water distribution, Water supply development, Saline water, Groundwater management, Leakage, Groundwater pollution, Water harvesting, Separated sewers, Groundwater recharge.

While the salt-water distribution system of St. Thomas in the U. S. Virgin Islands provides a readily abundant source of water for fire-fighting and sanitary flushing, there are drawbacks associated with the system. Leakage from the lines has caused saline water intrusion into the thin lens of fresh groundwater in Charlotte Amalie. Several shallow dug wells in the city served as a small but heavily-used source of water; however, the salinity of the water in these wells has since increased to a point where they have had to be abondoned. Introduction of large quantities of salt water into the sanitary sewer lines makes wastewater treatment difficult. The use of the salt-water distribution system in Christiansted, St. Croix has been reduced in order to lower the salt content of the town's wastewater for irrigation and groundwater recharge purposes. Salt water adversely affects metal pipes used in household plumbing. Plastic is being used more often and corrosion is no longer a severe problem. If the salt water mains were eliminated, the supply of groundwater in Charlotte Amalie would not be enough to meet demands. Supporters of the dual system maintain that reuse of treated wastewater probably never will be practiced in Charlotte Amalie because of lack of public support. There are no plans to expand the salt-water distribution system and repairs to the system are being made only when breaks occur in the lines. Though desalination costs are high, fire-fighting water supplies normally constitute < 1% of annual water consumption and it is more cost-effective to use this expensive water for fire fighting and sanitary purposes than to invest in an additional separate distribution system with very high maintenance costs. (See also W88-07850) (Geiger-PTT)
W88-07871

BERMUDA: APPLICATION OF NON-CONVENTIONAL WATER RESOURCES,
Public Works Dept., Hamilton (Bermuda).
E. N. Thomas.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 327-337.

Descriptors: *Water supply development, *Bermuda, *Desalination, *Water harvesting, *Water reuse, Water storage, Storage tanks, Groundwater mining, Water transport, Wastewater renovation, Recycling, Potable water, Reverse osmosis, Distillation, Wastewater treatment, Wastewater irrigation.

In Bermuda, about 95% of the population relies solely on roof catchment of rain water for its water supply. Standard roofs consist of overlapping Bermuda limestone painted white with a latex paint. Rain water is guided along the roof by glides to downpipes, and discharged by gravity into storage tanks, commonly located underneath the building. Small electric pumps are used to transfer the water from the storage tanks through a pneumatic tank to the plumbing of the house. Groundwater has been used to develop public water supplies. Three water truckers are licensed by the island's Water Authority to abstract water, and licensed by the Health Department to supply the public with potable water. The water is brackish and is treated by reverse osmosis. Approximately 2,200 wells supply individual domestic needs for non-potable uses. Since overall island demand for potable water exceeds that which can be met from roof catches and potable groundwater, desalination is carried out by reverse osmosis or electrodialysis for brackish water, and by reverse osmosis, distillation, or the Calfran process for seawater. The Bermuda Government encourages the use of non-potable saline water for flushing to reduce the demand for fresh water in parallel with piped potable systems. The traditional method of sewage disposal in Bermuda is to use unlined cesspits. One major hotel has an extended aeration, activated sludge plant, the product of which is used to irrigated its golf course. Grey water from kitchens and laundry is reused for irrigation. In one major hotel laundry wastewater is recycled for reuse as laundry washwater. One large agriculturist uses hydroponics to grow tomatoes. The Government of Bermuda plans to build a refuse incineration plant with energy recovery facilities. Energy recovered from the plant may be used for distillation of seawater, or for production of electricity for use in reverse osmosis for treatment of either brackish or seawater. (See also W88-07850) (Geiger-PTT)
W88-07872

CAYMAN ISLANDS: COUNTRY SITUATION REPORT,
The Water Authority, P.O. Box 1104, Grand Cayman.
For primary bibliographic entry see Field 3A.
W88-07873

CHINA: THE DEVELOPMENT AND USE OF NON-CONVENTIONAL WATER RESOURCES,
Bureau of Municipal Engineering and Public Utilities, Ministry of Urban and Rural Construction and Environmental Protection, Baiwanzhuang, Beijing, People's Republic of China.
S. Xu-Tong.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 349-353.

Descriptors: *China, *Water supply development, *Desalination, *Water reuse, *Water harvesting, Electrodialysis, Wastewater treatment, Developing countries, Distillation, Water storage, Drinking water, Potable water, Rural areas, Reverse osmosis, Wastewater irrigation.

China is expanding its efforts to exploit conventional groundwater and surface water resources, as well as its non-conventional water resources. Desalination technologies have been developed in China since the 1950's. Extensive research has been carried out on the electrodialysis, reverse osmosis, distillation and solar processes, and a large number of desalination stations have been established. In China, reuse of municipal wastewater for irrigation has a long history. The country is trying to improve the quality of wastewater for irrigation. Aquacultural wastewater treatment projects have been in use since 1960 throughout the country. The focal point for conserving water and developing water resources is to increase the industrial water reuse rate. In rural regions of the northwest and north of China, cellars or cisterns for storing water are used along with roof catchments. Collected rain water flows into a pool or pond for sedimentation and is then diverted to the cellar. A tablet of bleaching powder is added for disinfection. Typical cisterns hold enough water for a household for one or two years. To develop non-conventional water resources, techniques suitable to the local conditions should be adopted, and inexpensive

wind power, solar energy and other local resources should be used to make such technologies cost effective. (See also W88-07850) (Geiger-PTT)
W88-07874

CYPRUS: DEVELOPMENT OF NON-CONVENTIONAL WATER SOURCES,
Department of Water Development, Nicosia (Cyprus).
For primary bibliographic entry see Field 3A.
W88-07875

INDONESIA: THE USE OF NON-CONVENTIONAL WATER RESOURCES,
Water Quality and Environmental Div., Inst. of Hydraulic Engineering, Ministry of Public Works, Jakarta (Indonesia).
B. Mahbub.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 371-380, 4 fig, 4 tab.

Descriptors: *Water reuse, *Wastewater irrigation, *Cloud seeding, *Indonesia, *Water harvesting, Domestic wastes, Wastewater treatment, Aquaculture, Weather modification, Water supply development, Rural areas, Wastewater renovation, Potable water.

Non-conventional water resources are being developed in some areas of Indonesia where conventional sources are unavailable. Rain water is collected for potable use by Indonesians living where freshwater is difficult to find. Tanks used for collecting rain water include iron drums wooden tanks, concrete tanks, ferro-cement tanks, bamboo cement vessels, or fiberglass tanks. Several technologies have been developed to treat rain water collected from house roofs using sand filter systems: rapid sand filters or cisterns with slow sand filters. A peat water purification system is currently being developed on a household scale for people living in swampy areas of Kalimantan. River water can be purified by a coagulant derived from seeds of the Moringa Oleifera plant. This treatment has been used by the rural population in Java. Weather modification by cloud seeding is being developed by the Institute for Study and Application of Technology, Ministry of Research and Technology. Results show increased yields in some rice fields and increased power generation at a hydroelectric plant. Domestic wastewater is being used to irrigate rice fields and fish ponds. Pretreatment of domestic wastewater is essential prior to sending it into the irrigation network. To prevent an excessive amount of nitrogen from coming into the rice fields, control of dilution of domestic wastewater for irrigation is needed to achieve optimal cultivation of rice fields without using fertilizers. The health of farmers should be safeguarded, as they are in direct contact with water that still contains a high amount of bacteria. (See also W88-07850) (Geiger-PTT)
W88-07877

EGYPT: REUSE OF DRAINAGE WATER IN IRRIGATION,
Drainage Research Inst., Water Resources Centre, Ministry of Irrigation, Cairo (Egypt).
For primary bibliographic entry see Field 3B.
W88-07893

3D. Conservation In Domestic and Municipal Use

METROPOLITAN WATER MARKET DEVELOPMENT: SEATTLE, WASHINGTON, 1887-1987,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-07045

IDENTIFICATION OF MONTHLY TRENDS IN URBAN WATER USE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W88-07290

WATER MARKETING IN SOUTHERN CALIFORNIA,
Metropolitan Water District of Southern California, 1111 Sunset Blvd., Los Angeles, CA 90012.
For primary bibliographic entry see Field 6D.
W88-07378

URBAN USE OF ARIZONA'S RURAL GROUNDWATER,
City of Mesa, Box 1466, Mesa, AZ 85201.
For primary bibliographic entry see Field 6D.
W88-07379

3E. Conservation In Industry

WASTE-WATER REUSE IN INDUSTRY,
Agence Financiere de Bassin Seine-Normandie, Paris (France).
For primary bibliographic entry see Field 3C.
W88-07863

3F. Conservation In Agriculture

RELATIONSHIP BETWEEN WATER USE EFFICIENCY AND CUTICULAR WAX DEPOSITION IN WARM SEASON FORAGE CROPS GROWN UNDER WATER DEFICIT CONDITIONS,
Faculty of Applied Biological Science, Hiroshima Univ., Fukuyama, Hiroshima, 720 Japan.
H. Saneoka, and S. Ogata.
Soil Science and Plant Nutrition, Vol. 33, No. 3, p 439-448, 1987. 1 fig, 5 tab, 20 ref.

Descriptors: *Water stress, *Water use efficiency, *Leaves, *Cuticular transpiration, *Forages, *Sorghum, Lipids, Drought resistance, Carbon radioisotopes, Plant physiology, Radioactive tracers.

In order to clarify the relationship between water use efficiency (apparent photosynthetic rate/transpiration rate) and the syntheses and deposition of epicuticular wax and of lipids in leaf internal tissues in various forage crops with different drought tolerance, the contribution of cuticular wax to the leaf cuticular resistance to water loss under water stress was estimated. Under water stress conditions, the cuticular resistance of the drought tolerant plant Chloris gayana Kunth. increased about twofold compared with that of a well-watered plant, whereas the cuticular resistance of the sensitive plant Coix lacryma-jobi L. increased by about 10%. The amount of epicuticular wax deposited on the leaf surface in both plants increased by water stress. However, the amount in the tolerant plant was much higher than those in the sensitive one. Radioactivity of 14C incorporated into the leaf surface wax of stressed C. gayana and C. lacryma-jobi plants was 27 and 50% less than that of well-watered plants, respectively, when they were treated with 14C-malonate and 14C-acetate. Leaves of water-stressed C. gayana assimilated 14C from 14C-malonate and 14C-acetate into the lipids of their internal tissues 5.7 times more than the leaves of well-watered plants, while the leaves of water-stressed C. lacryma-jobi assimilated 78% of the amount recorded in well-watered plants. On the other hand, the cuticular resistance of bloom lines of Sorghum bicolor L. with a high accumulation of wax on the epicuticular surface increased by about 90% by water stress, whereas the cuticular resistance of a bloomless line with a low amount of wax increased by about only 15%. Water use efficiency of bloom lines of sorghum increased remarkably by water stress, whereas that of the bloomless line of sorghum decreased. These data suggest that in the drought-tolerant plants the water retention ability of the leaves increased due to the deposition of a larger amount of wax on their leaf surfaces, and a higher accumulation of lipids in internal tissues. Also these plants produced larger amounts of dry matter by increasing the water use efficiency through the reduction of cuticular evaporation under water stress conditions. (Author's abstract)
W88-06826

STUDIES ON IMPROVEMENT OF NUTRIENT AND WATER SUPPLY IN CROP CULTIVATION ON SAND DUNE SOIL: 2. EFFECT OF FERTILIZER PLACEMENT AND IRRIGATION METHOD ON GROWTH AND NUTRIENT UPTAKE OF TOMATOES,
Faculty of Agriculture, Tottori Univ., Koyama, Tottori, 680 Japan.
H. Fujiyama, and T. Nagai.
Soil Science and Plant Nutrition, Vol. 33, No. 3, p 461-470, 1987. 5 fig, 3 tab, 11 ref.

Descriptors: *Fertilization, *Surface irrigation, *Drip irrigation, *Sand, *Tomatoes, *Nutrients, *Water use efficiency, Crop yield cultivation, Phosphorus, Calcium, Sulfates, Mangesium.

Tomatoes (Lycopersicon esculentum Mill var. Houfuku) were cultivated in sand dune soil under the combinations of two fertilizer placements, i.e. 'surface' and 'bulk', and two irrigation methods, i.e. 'surface' and 'drip.' The availability of nutrients applied and the water use efficiency for dry matter production (WUD-D) and nutrient uptake (WUE-N) of plants were investigated. A drip irrigation method for the supply of the nutrient solution was compared with the above treatments. The surface placement brought about a high dry matter yield and nutrient uptake of plants only for surface irrigation. On the other hand, the bulk placement was favorable in the case of drip irrigation. Although the nutrient uptake was related to the dry matter yield, the coefficient of variation in nutrient uptake among the treatments, except for the nutrient-solution irrigation (DN), ranged from 52.7% for phosphorus to 30.5% for calcium. WUE-D and WUE-N were high in the case of surface irrigation-surface placement (SS) and low in the case of drip irrigation-surface placement (DS), that is, a better growth was accompanied with a higher WUE. The nutrient-solution irrigation brought about a high nutrient recovery rate and appears to be a suitable method for supplying nutrients and water in sand dune soil culture. Potassium movement in sand dune soil was related to sulfate movement, and calcium and magnesium movement to chloride. (Author's abstract)
W88-06828

MODELING THE IMPACT OF CONSERVATION TILLAGE PRACTICES ON PESTICIDE CONCENTRATIONS IN GROUND AND SURFACE WATERS,
AQUA TERRA Consultants, Mountain View, CA.
For primary bibliographic entry see Field 5B.
W88-06936

EFFICACY OF GRASSCARP FINGERLINGS IN WEED CONTROL CHAMBAL COMMANDED AREA INDIA,
For primary bibliographic entry see Field 4A.
W88-07052

COMPARISON OF TWO ONION IRRIGATION SCHEDULING PROGRAMS,
Colorado State Univ., Fort Collins.
E. G. Kruse, J. E. Ells, and A. E. McSay.
Journal of the American Society for Horticultural Science JOSHB5, Vol. 112, No. 5, p 738-742, September 1987. 4 tab, 8 ref.

Descriptors: *Irrigation programs, *Crop yields, *Water use efficiency, *Model studies, Irrigation efficiency, Irrigation practices, Irrigation requirements, Irrigation, Comparison studies, Onions, Field tests, Evaporation rate, Mathematical models.

Two onion (Allium cepa L.) irrigation scheduling procedures were compared in field studies over a 3-year period. The McSay-Moore model uses volume of distilled water evaporated from calibrated Bellani atmometers as a basis for predicting

irrigation. This model tells when to irrigate, but not how much to apply. The ARS/USDA model uses energy and aerodynamic equations to make estimates of evaporation rates from meteorological data. This model not only predicts when to irrigate, but also the amount to apply. Given the conditions for these experiments, onion yields and water use efficiencies were greater with the ARS/USDA than with the McSay-Moore model. (Author's abstract)
W88-07077

EFFECTS OF IRRIGATION TIMING ON SEEDLING ESTABLISHMENT AND PRODUCTIVITY OF SUBTERRANEAN CLOVER PASTURES,
Department of Agriculture and Rural Affairs, Kyabram Research Institute, R.M.B. 3010, Kyabram, Vic. 3620, Australia.
K. B. Kelly, and W. K. Mason.
Australian Journal of Experimental Agriculture AAAHAN, Vol. 27, No. 4, p 545-549, 1987. 1 fig, 3 tab, 12 ref.

Descriptors: *Irrigation effects, *Timing, *Seedlings, *Crop production, *Clovers, *Pastures, Plant growth, Dry matter, Grazing, Feeds, Irrigation efficiency, Irrigation practices.

Pure swards of subterranean clover were irrigated from late summer-autumn 1982 to autumn 1985. The period of irrigation varied, with 3 times of initial irrigation (1 February, 1 March, and 1 April) and 2 times of final irrigation (mid-October and mid-November). Seedling establishment, dry matter (DM) production and herbage quality were measured in grazed swards. In each regenerating year, seedling density increased as the time of initial irrigation was delayed from February (5.2 seedlings/sq dm) to April (20.5 seedlings/sq dm). For any time of initial irrigation, seedling density was increased by up to 100% in plots which were irrigated until mid-November in the previous spring. Dry matter yield was increased by early irrigation, with average yields of 11.1, 10.3, and 9.1 t/ha year achieved for February, March and April as times of initial irrigation respectively. Continuing irrigation until November increased annual yield by 0.76 to 1.58 tDM/ha. The late spring irrigation treatment gave increased spring growth plus increased growth in the following autumn as a result of increased seedling density. The quality of the feed produced in autumn was lower than that produced in winter (in vitro dry matter digestibility 68% compared with 75%), but was higher than the published dry matter digestibility values for paspalum pastures in autumn. Digestibility in spring declined rapidly, from 75% in September to about 50% in early December. The optimum time to begin irrigation will be a compromise between the animal requirements for pasture, the likelihood of dense establishment, and the costs associated with the greater amounts of water used to extend the growing season. (Shidler-PTT)
W88-07180

SIMPLE NON-WEIGHING LYSIMETER INSTALLATION WITH RAIN SHELTER,
Department of Soil Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Nainital, 263145, India.
For primary bibliographic entry see Field 7B.
W88-07184

SEMI-EMPIRICAL MODEL FOR CALCULATING EVAPORATION AND TRANSPIRATION FROM WETLAND RICE,
Division of Agricultural and Food Engineering, Asian Institute of Technology, P.O. Box 2754, Bangkok 10501, Thailand.
For primary bibliographic entry see Field 2D.
W88-07185

WATER UPTAKE BY PLANT ROOTS--A SIMULATION MODEL: I. CONCEPTUAL MODEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
For primary bibliographic entry see Field 2I.
W88-07192

COOL-SEASON TURFGRASS RESPONSES TO DROUGHT STRESS,
Rhode Island Univ., Kingston. Dept. of Natural Resources Science.
L. J. Aronson, A. J. Gold, and R. J. Hull.
Crop Science CRPSAY, Vol. 27, No. 6, p 1261-1266, November/December 1987. 5 fig, 16 ref.

Descriptors: *Irrigation requirements, *Turf grasses, *Drought resistance, *Moisture stress, Grasses, Soil water, Soil water potential, Leaves, Lysimeters, Evapotranspiration, Irrigation, Greenhouses, Tensiometers.

As the supply of water available for turf irrigation becomes limited, it is important to identify water-efficient and drought-tolerant turfgrasses. To establish the critical soil water potential at which cool-season turfgrasses begin to experience drought stress, the growth and quality responses of Poa pratensis 'Baron', Lolium perenne 'Yorktown II', Festuca rubra var. commutata 'Jamestown' and Festuca ovina var. duriuscula 'Tournament' to drought stress were compared in a greenhouse study. Evapotranspiration (ET) rates were measured using weighing lysimeters containing undisturbed cores of mature turf growing in a silt loam soil. Tensiometers and electrical resistance blocks were installed in a separate set of eight lysimeters containing L. perenne to determine the relationship between water loss due to ET and soil water potential. The ET rates of all grasses were unaffected until the soil water potential reached -50 to -80 kPa. During further soil water depletion, ET rates declined and drought stress symptoms became apparent. Leaf water potential of P. pratensis and L. perenne decreased by 50 to 75% when soil water potential declined to 80 kPa, while that of Festuca species remained relatively constant to a soil water potential of -400 kPa. Based on the parameters measured, P. pratensis and L. perenne exhibited a more rapid decline in ET rate, quality, and leaf growth under moisture stress than the two Festuca species, which demonstrated greater ability to thrive with limited soil moisture. (Author's abstract)
W88-07223

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS,
G. M. Higgins, P. J. Dieleman, and C. L. Abernethy.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 393-406, 1987. 4 fig, 7 tab, 5 ref.

Descriptors: *Irrigation, *Irrigation requirements, *Water requirements, *Future planning, *Projections, *Water resources development, *Irrigation engineering, Developing countries, Asia, Africa, Latin America, Caribbean, Agricultural hydrology, Irrigable land, Agriculture, Cultivation, Crop production, Environmental effects, Irrigation practices.

There are a number of reasons for expecting that a period is approaching in which irrigated agriculture in the developing countries will undergo significant changes. In much of south and west Asia, where > 30% of farming is irrigated cultivation, it is a familiar and well-understood activity; in Africa, where the relative share of irrigation is < 2% in most countries, this experience is not present, and training both of technicians and of farmers assumes much more importance for irrigation development. Although agricultural production and food supply of most south and east Asian countries (the majority of present irrigation activity) is now a great deal improved, the same cannot be said about most of Africa or Latin America and the Caribbean. Using indicative productivity figures, and assuming that the average food intake required is some 300 kg/year, the water requirements for a food strategy that is based on irrigation development are likely to be in the order of 600 to 3000 cu m/person/yr. In the past two decades, there have been a number of technological innovations in irrigation in the richer countries; except in Latin America, and some countries with oil-based economies, these newer technologies have spread little in the developing countries. Some contributions which hydrology can offer to irrigation include: (1) more measurement of the equity and timeliness of flows within canal distribution networks; (2) better data on droughts and low-flow periods; (3) increased attention to quantifying the water resources of smaller streams; and (4) increased data on river sediments. (Shidler-PTT)
W88-07251

PATTERNS AND TRENDS IN IRRIGATION EFFICIENCY,
Geography Department, University of New Mexico, Bandelier West, Room 118, Albuquerque, New Mexico 87131.
S. A. Thompson.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 57-63, February 1988. 4 fig, 1 tab, 14 ref.

Descriptors: *Irrigation, *Irrigation efficiency, *Long-term trends, *Irrigation water, Agricultural hydrology, Diversion, Great Plains, Data interpretation, Geography, Performance evaluation, Bureau of Reclamation, Time series analysis.

Irrigated agriculture is one of the most important water-use sectors in terms of total water diversion and consumptive use. For at least the last 25 years, improving irrigation efficiency has been a widely advocated and accepted goal. This paper uses a sample of 16 Bureau of Reclamation irrigation projects to examine the pattern of average irrigation efficiency and change in efficiency over time. In general, the highest average efficiencies are found in the arid Southwest while the lowest are found in the semi-arid to sub-humid Great Plains region. Over the 22-year period of analysis, there has been no observable trend toward improvement in efficiency at any of the projects. (Author's abstract)
W88-07278

AGRICULTURAL WATER MODELING AND ECONOMIC INFORMATION NEEDS UNDER THE MODEL WATER CODE,
Food and Resource Economics Department, University of Florida, G-099 McCarty Hall, Gainesville, Florida 32611.
For primary bibliographic entry see Field 6E.
W88-07282

VALUING IRRIGATION WATER: A SIMULATION/MATHEMATICAL PROGRAMMING APPROACH,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W88-07288

WATER LOSSES FROM IRRIGATION CANALS,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-07515

EFFECTS OF WATER DEFICIT ON VEGETATIVE GROWTH, FRUIT GROWTH AND FRUIT QUALITY IN COX'S ORANGE PIPPIN APPLE,
Ministry of Agriculture and Fisheries, Levin Horticultural Research Centre, Private Bag, Levin, New Zealand.
D. E. Irving, and J. H. Drost.
Journal of Horticultural Science JHSCA8, Vol. 62, No. 4, p 427-432, October 1987. 4 fig, 4 tab, 12 ref.

Descriptors: *Soil moisture deficiency, *Water deficit, *Fruit crops, *Irrigation programs, *Plant growth, *Crop yield, Apples, Water stress, Crop quality, New Zealand, Soil-water-plant relationships, Drought, Deficit irrigation.

Four-year old Cox's Orange Pippin apple trees were water-stressed in New Zealand to determine whether deficit irrigation could be used as a means of controlling vigour without reducing yield and whether fruit quality could be enhanced by moisture stress imposed at two different stages of fruit

development. Water deficit, imposed from 28 November 1985 until 3 January 1986 (Phase I), reduced shoot extension by 37% compared with the fully irrigated control trees. The level of soluble solids in fruit rose by 0.8%, the proportion of cracked fruit increased 2-3 fold, and the incidence of bitter pit declined marginally, but mean fruit size and titratable acidity were not altered when compared with fruit from the control trees. When water deficit was imposed from 4 January until harvest on 21 February 1986 (Phase II), shoot growth declined by only 7%. The level of soluble solids rose by 1%, but the incidence of bitter pit and mean fruit size were not affected. Neither of the irrigation treatments significantly reduced crop density or crop yield. (Wood-PTT)
W88-07692

EFFECT OF SOIL WATER POTENTIAL, METHOD OF IRRIGATION AND NITROGEN ON PLANT WATER RELATIONS, CANOPY TEMPERATURE, YIELD AND WATER USE OF RADISH,
Division of Soil Science, Indian Institute of Horticultural Research, Hessaraghatta Lake P.O., Bangalore-650089, India.
D. M. Hegde.
Journal of Horticultural Science JHSCA8, Vol. 62, No. 4, p 507-511, October 1987. 1 fig, 2 tab, 8 ref.

Descriptors: *Soil-water-plant relationships, *Irrigation practices, *Soil water potential, *Fertilizers, *Crop yield, *Water use efficiency, Radishes, Canopy, Nitrogen, Irrigation efficiency, Basin irrigation, Furrow irrigation, Water use, Temperature, Osmotic pressure, Evapotranspiration.

The effects of irrigation at three soil water potentials under basin and furrow systems of irrigation with different levels of nitrogen on plant water relations, canopy temperature, water use and yield of radishes were investigated in 1983 and 1984. Frequent irrigations at -20 kPa soil water potential increased relative water content, leaf water potential, osmotic potential, yield, evapotranspiration, and water use efficiency, and decreased canopy temperature as compared to irrigation at -40 and -60 kPa. However, the difference in yield between irrigations at -20 and -40 kPa was not significant. Methods of irrigation had no significant effect on the relative water content, leaf water potential, osmotic potential, evapotranspiration or canopy temperature, although furrow irrigation resulted in slightly higher yield and water use efficiency for both years. Nitrogen up to 120 kg/ha increased turgor potential, yield, evapotranspiration and water use efficiency. (Wood-PTT)
W88-07693

CHARACTERIZING WATER USE BY IRRIGATED WHEAT AT GRIFFITH, NEW SOUTH WALES,
Centre for Irrigation and Freshwater Research, Commonwealth Scientific and Industrial Research Organization, Griffith, N.S.W. 2680.
W. S. Meyer, F. X. Dunin, R. C. G. Smith, G. S. G. Shell, and N. S. White.
Australian Journal of Soil Research ASORAB, Vol. 25, No. 4, p 499-515, 1987. 6 fig, 3 tab, 34 ref, 4 append.

Descriptors: *Irrigation efficiency, *Water use efficiency, *Irrigation programs, *Water use, *Wheat, Agronomy, Crop production, Agriculture, Crop yield, Irrigation, Australia, Water management, Lysimeters, Evaporation rate, Evaporation, Estimating equations, Model studies.

Wheat is being grown increasingly in the irrigated areas of south-east Australia. Its profitability depends on high yields, which in turn, are highly dependent on accurate water management. This combination, together with the increasing need for greater water use efficiency to minimize accessions to rising water-tables, calls for effective irrigation scheduling. To achieve this, accurate estimates of crop water use and upward fluxes of water into the root zone from shallow water-tables are required. A weighing lysimeter, installed in 1984, measured hourly actual evaporation from a wheat crop which enabled the accuracy of water use estimates to be assessed. Daily potential evaporation was calculated from a combination equation previously calibrated over lucerne, while previously developed crop coefficients for wheat were used to convert potential evaporation to estimated actual evaporation. Daily actual evaporation was the major component in a water balance model for irrigated wheat. The model was quite efficient, but with a bias of -8.8%, which indicated that actual evaporation values were generally underestimated. The underestimate was due primarily to the wind function used in the calculation of potential evaporation and alternative functions for both daily and hourly calculations were derived. The 1984 lysimeter data also showed that change in soil water content was accurately measured with the field-calibrated neutron probe. Comparisons of measured and estimated water use from field experiments in 1981 and 1982 indicated that upward flux from a water-table between 1.5 and 2.1 m below the soil surface may be up to 30% of daily actual evaporation. This upward flux will need to be taken into account if irrigation scheduling is to promote efficient use of irrigation water. (Author's abstract)
W88-07702

AGRICULTURAL MANAGEMENT AND WATER QUALITY.
For primary bibliographic entry see Field 5G.
W88-07820

AGRICULTURAL PROBLEMS AND ISSUES AS RELATED TO AGRICULTURAL MANAGEMENT PRACTICES AND WATER QUALITY,
Iowa Agricultural and Home Economics Experiment Station, Ames.
For primary bibliographic entry see Field 5G.
W88-07822

BEST MANAGEMENT PRACTICE IMPLEMENTATION ECONOMICS AND FARMER DECISION MAKING,
Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W88-07839

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

RESTORING THE SINUOSITY OF ARTIFICIALLY STRAIGHTENED STREAM CHANNELS,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
A. Brookes.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 1, p 33-41, 1987. 5 fig, 53 ref.

Descriptors: *Sinuous flow, *Stream improvement, *Slope stabilization, *Hydraulic engineering, *Channel improvement, Watercourses, Bank protection, Bed load, Denmark.

Restoration of Danish stream channels is encouraged by the Watercourse Act of 1982 and has been undertaken partly because of the adverse physical and biological effects caused by artificial straightening. A new technique for restoring morphologic and hydrologic diversity to stream channels has been developed, exemplifying the concept of working with nature rather than against it. This relies on re-creating the former sinuosity, cross-sectional dimensions, slope and substrate of a stream channel. Natural fluvial features are restored to a channel, and because slope is decreased stability is probable. In turn, this could be beneficial to the flora and fauna of a watercourse and to aesthetic qualities. The technique was applied successfully to a small stream in southern Jutland, Denmark, in 1984/5. Additional methods of bank and bed protection were required to limit subsequent minor adjustments along the new course. Further applications of the technique need to be treated individually because of varying local hydrologic and sedimentologic conditions. On-site supervision during construction and planned maintenance are vital components of restoration. (Author's abstract)
W88-06962

REGULATED FLUSHING IN A GRAVEL-BED RIVER FOR CHANNEL HABITAT MAINTENANCE: A TRINITY RIVER FISHERIES,
Battelle Memorial Inst., Denver, CO. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5G.
W88-06965

STREAM CORRIDOR MANAGEMENT IN THE PACIFIC NORTHWEST: I. DETERMINATION OF STREAM-CORRIDOR WIDTHS,
Washington State Univ., Pullman. Program in Environmental Science and Regional Planning.
W. W. Budd, P. L. Cohen, and P. R. Saunders.
Environmental Management EMNGDC, Vol. 11, No. 5, p 587-597, September 1987. 9 fig, 2 tab, 43 ref.

Descriptors: *Stream corridors, *Bank protection, Optimization, Watershed management, Environmental planning, Washington, Wetlands, Banks.

The growth of King County, Washington, part of the rapidly growing Pacific Northwest region, has placed pressure on stream corridors. The existing literature on regional stream corridors was reviewed and a case study of the Bear-Evans Creek watershed was undertaken to provide guidelines for determining optimal stream corridor widths. The results indicate that practical determinations of stream corridor widths can be efficiently made using a simple field survey of select reaches of a stream system combined with an analysis of soils, vegetation, physiography, and land-use characteristics. A 15-m buffer width was found to be an adequate protection buffer for many reaches of the Bear-Evans Creek watershed. For stream bank slopes >40% and in wetland regions, additional data are required. (See also W88-06970) (Freemann-PTT)
W88-06969

STREAM CORRIDOR MANAGEMENT IN THE PACIFIC NORTHWEST: II. MANAGEMENT STRATEGIES,
Design and Development Department, City of Bellevue, P.O. Box 90012, Bellevue, Washington 98009-9013.
P. L. Cohen, P. R. Saunders, and W. W. Budd.
Environmental Management EMNGDC, Vol. 11, No. 5, p 599-605, September 1987. 1 fig, 1 tab, 18 ref.

Descriptors: *Channel morphology, *Stream stabilization, *Administrative regulations, *Streamflow depletion, Optimization, Watershed management, Envrionmental planning, Management planning, Washington.

The scientific literature and a case study was reviewed to suggest future management strategies and guidelines for controlling development in King County, Washington, watersheds. King County contains Federal and Indian lands as well as lands administered by the State Department of Natural Resources, all of which have regulations and policies that affect stream corridor management. The remainder of King County includes 20 incorporated cities in the Seattle metropolitan area and unincorporated King County. A case study of the Bear-Evans Creek watershed resulted in eight recommendations for stream corridor management, six of which are site-specific. The recommendations include bridging of stream channels limiting livestock access, rehabilitation of stream channels and bank, relocation of certain types of streams, stormwater discharge, placement of riparian strips along stream corridors, new development along stream corridors, and the inclusion of slopes >40% and

all wetlands within stream corridor. Existing policies and permit codes will require amendment to incorporate these recommendations. (See also W88-06969) (Freemann-PTT)
W88-06970

REVERSIBLE PROCESS CONCEPT APPLIED TO THE ENVIRONMENTAL MANAGEMENT OF LARGE RIVER SYSTEMS,
UA CNRS 367 Laboratoire d'Ecologie des Eaux Douces, Universite Lyon 1, 69622 Villeurbanne Cedex, France.
For primary bibliographic entry see Field 2H.
W88-06971

EFFICACY OF GRASSCARP FINGERLINGS IN WEED CONTROL CHAMBAL COMMANDED AREA INDIA,
K. P. Sharma, A. P. Tyagi, and R. Saxena.
Environmental Education and Information, Vol. 6, No. 3, p 255-261, July-September 1987. 1 fig, 1 tab, 11 ref.

Descriptors: *Aquatic plants, *Weed control, *Carp, *India, *Irrigation canals, Agriculture, Irrigation, Drainage, Food habits, Aquatic habitats, Plants, Fish, Water level, Floods.

Effective irrigation in the Chambal-commanded area of Kota (about 1,500 ha) in Rajasthan State has been obstructed because of aquatic weed infestation. Consequently, the discharge carrying capacity of the canal system has been reduced by 40-45%. Furthermore, obstruction by aquatic weeds has caused an increase in the height of the water column throughout the canal system, resulting in frequent water overflows and the submersion of the adjoining cultivable areas. Aquatic weeds in the right main canal were removed by the grasscarp fingerlings in varying degrees. The removal of Hydrilla verticillata was the greatest (5,65%). Potamogeton perfoliatus, Najas major and Ceratophyllum demersum were also removed in fairly large quantities. Though an order of preference for aquatic weeds by the grasscarp fingerlings may be established on the basis of the present investigations, the quantity removed was not very significant. This was probably because of the small size of the fish (125-150 mm) and the small number released in relation to the area infested. Because of a lack of knowledge of the habitat preferred by the fish, the efficacy of grasscarp in the removal of weeds cannot be forecast with certainty. It is a riverine fish and has been observed moving in groups. It prefers comparatively calm and shallow waters near the banks of the canal. This preference is perfectly in accord with the availability of vegetation. (Alexander-PTT)
W88-07052

ECOLOGICAL EFFECTS OF COASTAL MARSH IMPOUNDMENTS: A REVIEW,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 6G.
W88-07100

BACKFILLING CANALS TO MITIGATE WETLAND DREDGING IN LOUISIANA COASTAL MARSHES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. Neill, and R. E. Turner.
Environmental Management EMNGDC, Vol. 11, No. 6, p 823-836, November 1987. 7 fig, 6 tab, 36 ref.

Descriptors: *Water management, *Environmental effects, *Coastal marshes, *Backfill, *Canals, *Dredging, *Wetlands, *Mitigation measures, Louisiana, Spoil banks, Vegetation regrowth, Aquatic habitats, Habitats, Flow control, Bank protection, Organic matter, Wildlife, Fish.

Thirty-three backfilled canals in Louisiana were evaluated to assess the success of habitat restoration. Criteria were based on canal depth, vegetation recolonization, and regraded spoil bank soils after backfilling. Restoration success depended on marsh type, canal location, canal age, marsh soil characteristics, the presence or absence of a plug at the canal mouth, whether mitigation was on- or off-site, and dredge operator performance. Backfilling reduced median canal depth from 2.4 to 1.1 m. Median cover of marsh vegetation on the spoil banks was 51.6%; in the canal, 0.7%. The organic matter and water content of the spoil bank soils were restored to values intermediate between spoil bank levels and predredging marsh conditions. Cover of marsh vegetation on backfilled spoil banks was highest in intermediate marshes (68.8%) and lowest in fresh (34.7%) and salt marshes (33.9%). Average canal depth was greatest in intermediate marshes (1.50 m) and least in fresh marshes (0.85 m). Canals backfilled in marshes with more organic soils were deeper, probably as a result of greater loss of spoil volume caused by oxidation of soil organic matter. Canals more than ten years old at the time of backfilling had shallower depths after backfilling. Canal size showed no relationship to canal depth or amount of vegetation reestablished. Plugged canals contained more marsh reestablished in the canal and much greater chance of colonization by submerged aquatic vegetation compared with unplugged canals. Backfilling of canals resulted in shallow water areas with higher habitat value for benthos, fish, and waterfowl as compared with unfilled canals. Removal of spoil banks may also help restore water flow patterns over the marsh surface. (Cassar-PTT)
W88-07104

ANALYSES OF RESERVOIR STORAGE REALLOCATIONS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
R. A. Wurbs, and L. M. Cabezas.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 77-95, June 30, 1987. 2 fig, 4 tab, 11 ref.

Descriptors: *Water management, *Reservoir operation, *Water demand, *Water storage, *Water allocation, *Risks, *Economic evaluation, *Flood damage, *Storage, *Flood control, Management planning, Water supply, Industrial water, Economic evaluation, Optimization, Water conservation, Multipurpose reservoirs, Hydrologic models, Simulation analysis, Waco Reservoir, Texas, Water shortage, Water loss.

A hydrologic and economic evaluation procedure was used to analyze proposed reallocations of reservoir storage capacity between flood control and municipal and industrial water supply. The procedure involved evaluation of risks and consequences of failing to prevent flooding and failing to meet water demands, associated with alternative allocations of storage capacity between flood control and water supply. Unlike traditional practices based on firm yield and reliability, water supply was treated analogously with flood control, with economic consequences of water shortages being quantified. Average annual flood losses were computed using the damage-frequency method. Average annual water supply losses were estimated by developing a water shortage versus economic loss function, which was then applied to water shortages computed by a hydrologic simulation. The water shortage versus loss function reflected emergency demand management and supply augmentation measures. Average annual water supply losses were estimated for a given demand level. Long-term demand management strategies were reflected in the water demand projection. A case study involved the proposed storage capacity reallocation in the Waco Reservoir, Texas, on the Bosque River. This multipurpose reservoir is used for flood control, municipal and industrial water supply, and recreation. (Cassar-PTT)
W88-07109

CRASSULA HELMSII (T. KIRK) COCKAYNE: IS IT AN AGGRESSIVE ALIEN AQUATIC PLANT IN BRITAIN,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W88-07177

INTERBASIN WATER TRANSFERS IN RIPARIAN STATES: A CASE STUDY OF GEORGIA,
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W88-07281

EFFECTS OF DIVERSION ON THE NORTH AMERICAN GREAT LAKES,
Rm. 6440, Social Science Bldg., University of Wisconsin, Madison, Wisconsin 53706.
For primary bibliographic entry see Field 6F.
W88-07287

EFFECTS OF VARIABLE DISCHARGE SCHEMES ON DISSOLVED OXYGEN AT A HYDROELECTRIC STATION,
RMC-Environmental Services, 1921 River Road, P.O. Box 10, Drumore, Pennsylvania 17518.
For primary bibliographic entry see Field 5G.
W88-07289

DETERMINISTIC APPROACH TO INFLOW DESIGN RAINFLOOD DEVELOPMENT AS APPLIED BY THE U.S. BUREAU OF RECLAMATION,
Flood Section, U.S. Bureau of Reclamation, PO Box 25007, Denver, CO 80225.
For primary bibliographic entry see Field 2A.
W88-07406

PREDICTION OF FLOOD FREQUENCY IN SAUDI ARABIA,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-07477

FLOOD ALLEVIATION SCHEME FOR LOWER RIVER MOLE,
For primary bibliographic entry see Field 8B.
W88-07489

SHORT-TERM SLIPPING OF A SHALLOW EXCAVATION IN GAULT CLAY,
For primary bibliographic entry see Field 8A.
W88-07490

SEEPAGE UNDERNEATH BARRAGES WITH DOWNSTREAM SUBSIDIARY WEIRS,
Alexandria Univ. (Egypt). Faculty of Engineering.
M. A. Elganainy.
Applied Mathematical Modeling AMMODL, Vol. 11, No. 6, p 423-431, December 1987. 7 fig, 9 ref.

Descriptors: *Egypt, *Barrages, *Weirs, *Seepage, *Uplift pressure, *Nile River, Engineering, Mapping, Mathematical models, Channel improvement, Pressure head.

A subsidiary weir with a sloping middle apron may be constructed downstream from each of the existing barrages on the River Nile in Egypt to secure its stability against the increase in effective heads. The problem was mathematically solved by a conformal mapping technique. Formulas were obtained to calculate the uplift pressures acting on the existing barrage and the subsidiary weir. Formulas were also derived to calculate the exit gradients along the intermediate filter and the downstream bed. The seepage characteristics for a wide range of boundary conditions were calcualted, the results were plotted in the form of curves, and analyzed for effects of uplift pressure on the existing structure and on the subsidiary weir, and for changes in the exit gradients. (Author's abstract)
W88-07491

WAVE ATTENUATION BY RUBBLE-LINED CHANNEL WALLS,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 8B.
W88-07508

Group 4A—Control Of Water On The Surface

SEEPAGE FROM CHANNELS AND PONDS WITH IMPERVIOUS BOUNDARY WALLS EXTENDING BELOW FLOOR LEVEL,
Soils Division, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ (U.K.).
For primary bibliographic entry see Field 2G.
W88-07510

PARAMETER ESTIMATION MODEL FOR UNGAGED STREAMFLOWS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-07513

DEVELOPMENT OF FLOOD FORECASTING AND WARNING SYSTEM IN CHI AND MUN RIVER BASINS, NORTHEAST THAILAND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 2E.
W88-07556

4B. Groundwater Management

COMPARISON OF MODELS THAT DESCRIBE THE TRANSPORT OF ORGANIC COMPOUNDS IN MACROPOROUS SOIL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-06937

ALLOCATION OF AQUIFER RESOURCES IN SCOTLAND,
British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, Scotland.
For primary bibliographic entry see Field 6B.
W88-06963

PLANNING MODEL FOR OPTIMAL CONTROL OF SALTWATER INTRUSION,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis, and B. A. Finney.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 163-178, March 1988. 8 fig, 5 tab, 30 ref. NSF Grants INT 84-19906 and INT 82-03044.

Descriptors: *Planning, *Model studies, *Saline water intrusion, *Groundwater management, *Groundwater recharge, Saline-freshwater interfaces, Mathematical studies, Optimization, Finite element method, Taiwan.

A planning model for the control of seawater intrusion in regional groundwater systems was structured as a problem in optimal control. The hydraulic response equations, which were developed from continuity principles, relate the movement of the interface to the magnitude and location of groundwater pumping and recharge. Finite difference methods were used to approximate the solution of the aquifer's response to management strategies. The control problem was solved using: (1) The influence-coefficient method allied with quadratic programming; and (2) reduced-gradient methods in conjunction with a quasi-Newton algorithm. The planning model was applied to the Yun Lin groundwater basin in southwestern Taiwan where excessive pumping has produced declining water levels, localized land subsidence, and saltwater intrusion. The optimal groundwater pumping and recharge schedules for the Peikang area of the basin are presented. The computational efficiency of the algorithms is discussed. (Author's abstract)
W88-07044

NATURAL WETLANDS ON SHINGLE AT DUNGENESS, KENT, ENGLAND,
Botany Department, Royal Holloway and Bedford New College, Huntersdale, Callow Hill, Virginia Water, Surrey GU25 4LN, U. K.
For primary bibliographic entry see Field 2H.
W88-07178

SIMPLE NON-WEIGHING LYSIMETER INSTALLATION WITH RAIN SHELTER,
Department of Soil Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Nainital, 263145, India.
For primary bibliographic entry see Field 7B.
W88-07184

FINITE-ELEMENT SIMULATION OF LOW-TEMPERATURE, HEAT-PUMP-COUPLED, AQUIFER THERMAL ENERGY STORAGE,
Kent State Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-07190

DETAILED INVESTIGATION OF PHYSICAL AND BIOLOGICAL CLOGGING DURING ARTIFICIAL RECHARGE,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, and R. B. Suazo.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 119-140, September 1987. 14 fig, 4 tab, 22 ref.

Descriptors: *Groundwater recharge, *Recharge, *Artificial recharge, *Clogging, Model studies, Mathematical models, Simulation, Infiltration rate, Soil properties, Particle size, Flooding, Discharge measurement, Suspended solids, Biological oxygen demand, Chemical oxygen demand, Head loss.

An attempt was made to study clogging with an experimental model that simulates artificial recharging practices by considering factors such as effective infiltration rate, media size and depth, and inundation period. Recharging was investigated experimentally in terms of suspended solids removal, 3-day biological oxygen demand removal, and chemical oxygen demand removal at different sand sizes and infiltration rates. To understand the physical phenomena involved, the effect of suspended solids concentration and initial infiltration rate on cumulative discharge was studied and verified using a simple mathematical model. The simulated cumulative discharge profiles were comparable with experimental profiles. This indicates that an empirical relationship can be used to successfully predict biological clogging at different recharge rates. Conclusions that can be made from the results of the experiments include the following: (1) the rate of decrease in the infiltration rate is faster when higher initial infiltration rates are applied; (2) biological clogging at different recharge rates can be successfully predicted from cumulative discharge, initial infiltration rate, and inundation period; (3) an improvement in suspended solids and 3-day biological oxygen demand removal was observed in the early stages of recharge, followed by an almost constant removal; (4) a decrease in head-loss with time was observed after an initial increase; (5) the major removal is confined to the top few centimeters of the bed. (Author's abstract)
W88-07265

OPTIMAL GROUNDWATER MANAGEMENT IN TWO-AQUIFER SYSTEMS,
Erftverband, Paffendorfer Weg 42, D-5010 Bergheim FRG.
W. Lindner, K. Lindner, and G. Karadi.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 27-33, February 1988. 5 fig, 9 ref.

Descriptors: *Unconfined aquifers, *Confined aquifers, *Groundwater management, *Optimization, *Well hydraulics, Simulation, Linear programming, Numerical modeling, Computers, Aquifer systems, Groundwater movement, Geohydrology.

A numerical model is presented for the prediction of optimal ground water withdrawal from a two-aquifer system by observing a set of constraints determined by the ecological conditions of the ground water basin. The aquifer system consists of an upper unconfined and a lower confined aquifer with a leaky stratum between them. It is assumed that water is withdrawn from the confined aquifer only, but the unconfined aquifer will also be affected due to the leakiness of the layer separating the upper and lower aquifers. Simulation and linear programming are employed for developing a computer model for the optimal management of such systems, with the objectives of determining withdrawal rates for predetermined ground water levels. (Author's abstract)
W88-07274

ARTIFICIAL RECHARGE OF GROUND WATER,
Delft University of Technology, Division of Sanitary Engineering and Water Management, Delft, The Netherlands.
L. Huisman, and J. H. Kop.
Water Resources Journal, No. 154, p 60-67, September 1987. 9 fig, 3 ref.

Descriptors: *Water management, *Recharge, *Groundwater recharge, Artificial recharge, Water treatment, Aquifers, Artesian aquifers, Filtration, Bank filtration, Induced filtration, Coastal aquifers, Rivers, Water conservation, Waste disposal, Water purification, Industrial water, Water storage, Storage, Water spreading.

Groundwater yield from a limited catchment area may be increased by artificial recharge. Likewise, the surrounding area which must be protected from pollution can be decreased through recharge programs. River bank filtration is a natural form of recharge. Although it has many advantages, potential pollution is a major danger. Artificial recharge overcomes some of these problems, allowing pretreated river water to enter an aquifer in one way or another. High capacity recharge is possible in deep water table aquifers using a spreading pond or a circle of injection wells. Artificial recharge of artesian aquifers can push back saline water intrusion; however, brackish water can often enter the pumping wells. Artificial recharge can also be used to remove suspended matter from turbid river water, to detain water underground for pathogen removal, to polish quality after removal of major quantities of impurities, and to store water during dry periods. Techniques to increase the rate of water absorption in water spreading include turbidity removal, chemical treatment of water, mechanical treatment of the soil surface, planting of vegetation, chemical treatment of soil, treatment of soil with organic matter, and rotation of spreading and drying. Artificial recharge can also be used to protect wetlands during construction and for disposal of storm water and septic tank effluent. (Cassar-PTT)
W88-07558

POTENTIAL USE OF THE DEEP AQUIFERS IN THE NEGEV DESERT, ISRAEL - A CONCEPTUAL MODEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 3C.
W88-07580

GEOCHEMICAL CALCULATIONS AND OBSERVATIONS ON SALT WATER INTRUSIONS, I.A. COMBINED GEOCHEMICAL/MIXING CELL MODEL,
Institute for Earth Sciences, Vrije Universiteit, De Boelelaan 1085, 1081 HV Amsterdam (The Netherlands).
For primary bibliographic entry see Field 2L.
W88-07583

APPROPRIATE TECHNOLOGY FOR WATER RESOURCES DEVELOPMENT,
Agence Financiere de Bassin Seine-Normandie, Paris (France).
P. Douard.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 317-320, 1 ref.

Descriptors: *Artificial recharge, *Groundwater recharge, *Developing countries, *Pipelines, *Leakage, Water reuse, Maintenance, Cost analysis, Water supply development, Case studies, Capital costs, Water loss, Feasibility studies.

If appropriate technologies were used in the field of water resources and supply, the cost of supplying water to world populations could be halved. An appropriate technology should be cost effective and easy to operate and maintain. Examples of appropriate technology are given using two cases of non-conventional water resources: artifical recharge and leakage control. Artificial recharge has been used in the 'Water Resources in North Africa' project where aquifers can be recharged with either surface or waste water. At a site located near Marrakesh, Morocco, four basins are separated by small embankments fed by a stream. From the upper to the lower course of the stream, each tank acts first for infiltration and then for settling. The stored water can be reused for irrigation as well as for the urban needs of Marrakesh. The project uses a local and inexpensive workforce, is simple to operate and manage, and requires little maintenance of the basins. The case of Creances, a village situated in Normandy, presents an example of wastewater recharge. The village cleans its wastewater from oyster processing and then reuses it for irrigation of carrot crops. The wastewater is infiltrated through sand dunes after treatment by screening and oil removal. Remarkable purification is obtained in this low cost, easily maintained project. Although strictly not a non-conventional resource, leakage control is a cause for concern in every country where water supply is scarce. As there is no precise international requirement for leakage control, and as the technologies depend on local conditions (shape of the network, pipe materis), technologies used have a greater chance to be appropriate and an economical appraisal of a leakage control policy is usually achieved. In the case of Addis Ababa, three programs were considered: regular sounding comprising a small central loss control data and advisory section, with annual surveys of all consumers' connections and main pipelines; intensive sounding alone; and intensive sounding and district metering. The last program was chosen together with improved meter maintenance, which helped to guarantee that the techniques used were cost effective. (See also W88-07850) (Geiger-PTT)
W88-07870

DUAL WATER SYSTEMS IN THE UNITED STATES VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W88-07871

BERMUDA: APPLICATION OF NON-CONVENTIONAL WATER RESOURCES,
Public Works Dept., Hamilton (Bermuda).
For primary bibliographic entry see Field 3C.
W88-07872

CYPRUS: DEVELOPMENT OF NON-CONVENTIONAL WATER SOURCES,
Department of Water Development, Nicosia (Cyprus).
For primary bibliographic entry see Field 3A.
W88-07875

ETHIOPIA: SOME NON-CONVENTIONAL WATER RESOURCE TECHNOLOGIES,
Research and Development in Rural Pumping Technologies, Ethiopian Water Works Construction Authority, P.O. Box 385, Addis Ababa (Ethiopia).
For primary bibliographic entry see Field 3A.
W88-07876

GROUNDWATER AND AQUIFERS: AN OVERVIEW OF 'EXOTIC' USES,
Binnie and Partners, London (England).
K. J. Edworthy, and S. Puri.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 2, p 87-95, 1986. 4 fig, 2 tab, 45 ref.

Descriptors: *Groundwater management, *Aquifers, *Waste management, *Fluid storage, *Energy sources, *Waste disposal, *Energy, Energy conservation, Mineral leaching, Fluid storage, United Kingdom, Wells, Leaching.

There is a range of uses for groundwater and aquifers, mostly non-water supply uses, which have been termed 'exotic.' These uses can be categorized into four distinct fields: fluid storage and waste disposal, including deep-well injection; energy conservation, including fossil fuel-generated energy (as heat or pressure) and the extraction of solar energy from groundwater; subsurface in situ leaching of economic minerals; and groundwater quality management. Some details of each of these fields of application are presented to illustrate their essential multi-disciplinary nature and also the benefits that can arise from their use. Much more intensive investigation than normal is considered necessary to obtain the detailed site-specific data that any application would require. This would also have to be linked with an adequate regional monitoring system, which protects potable groundwater and other minerals. Possible applications in the United Kingdom are considered. (Author's abstract)
W88-07910

ENERGY POTENTIAL OF IRISH GROUNDWATERS,
Geological Survey of Ireland, Beggars Bush, Dublin 4, Ireland.
C. R. Aldwell, and D. J. Burdon.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 2, p 133-141, 1986. 3 fig, 5 tab, 20 ref.

Descriptors: *Groundwater management, *Solar energy, *Geothermal resources, *Cold springs, *Warm springs, *Aquifers, *Ireland, *Groundwater potential, Heat pumps, Tepid springs, Energy potential, Temperature.

The energy potential of Irish groundwater is assessed, and its sources summarized. The two sources of energy, solar and geothermal, are outlined. The manner in which water and energy are united is described. The recovery of energy may be from the warm springs areas, from the tepid springs areas or from the high yielding cold aquifers underlying some 27% of the country. Heat pumps will be essential for their development. It is concluded that both solar and geothermal energies are of importance in Ireland; that energy extraction from the warm and tepid springs has limited potential; and that cold groundwater offers the best energy potential from Irish groundwaters. (Author's abstract)
W88-07912

GROUNDWATER MANAGEMENT PROBLEMS IN ABANDONED COAL-MINED AQUIFERS: A CASE STUDY OF THE FOREST OF DEAN, ENGLAND,
Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W88-07916

PROBLEMS IN THE RECOGNITION OF SEAWATER INTRUSION BY CHEMICAL MEANS: AN EXAMPLE OF APPARENT CHEMICAL EQUIVALENCE,
Birmingham Univ. (England). Hydrogeology Section.
For primary bibliographic entry see Field 5B.
W88-07917

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF CLEAR-CUT LOGGING ON WOOD BREAKDOWN IN APPALACHIAN MOUNTAIN STREAMS,
Biology Dept., Virginia Polytechnic Institute and State Univ., Blacksburg, VA 24061.
S. W. Golladay, and J. R. Webster.
American Midland Naturalist AMNAAF, Vol. 119, No. 1, p 143-155, January 1988. 2 fig, 5 tab, 66 ref. NSF Grants BSR 8316000 and DEB 8012093.

Descriptors: *Oak trees, *Clear-cutting, *Logging, *Hardwood, *Decomposition, *Streams, *Detritus, Nitrates, Invertebrates, Water temperature, Mountains.

Red oak (Quercus rubra) sticks, approximately 10-cm long and in three size classes (large, 3-cm diam, 22-55 g; medium, 1-2-cm, 12-22 g; small < 1-cm, 3-12 g) were placed at five sites in two second-order streams at Coweeta Hydrologic Laboratory. One stream, Big Hurricane Branch, drains a watershed logged in 1976 (WS 7); the other stream, Hugh White Creek, drains an uncut reference watershed (WS 14). Ten sticks of each size class were collected from each site at 6-month to 1-year intervals from September 1981 through November 1985. Calculated exponential breakdown rates ranged from 0.107 to 0.281/y. Breakdown rates were significantly different among size classes on both watersheds - smaller sticks lost mass faster than larger sticks. Breakdown rates of similar size sticks were significantly faster in Big Hurricane Branch, the disturbed stream, than in Hugh White Creek. Faster rates of wood breakdown in Big Hurricane Branch may be associated with higher stream NO3-N levels, greater stream channel instability and greater invertebrate abundance on sticks. (Author's abstract)
W88-06837

ECOLOGICAL CONSEQUENCES OF MECHANICAL HARVESTING OF CLAMS,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
C. H. Peterson, H. C. Summerson, and S. R. Fegley.
Fishery Bulletin FSYBAY, Vol. 85, No. 2, April 1987. 5 fig, 8 tab, 45 ref.

Descriptors: *Ecological effects, *Clam harvesting, *Field tests, *Clams, *Estuaries, North Carolina, Species composition, Macroinvertebrates, Biomass, Seagrass, Polychaetes.

A field experiment was performed in 1,225 sq m plots in each of two shallow estuarine habitats, a seagrass bed and a sand flat, in Back Sound, North Carolina, to test the impact of clam raking and two different intensities of mechanical harvesting of clams ('clam kicking') for up to 4 years on (1) hard clam, Mercenaria mercenaria, recruitment, (2) seagrass biomass, (3) the density of benthic macroinvertebrates, and (4) the density of bay scallops, Argopecten irradians. The removal of adult hard clams with the contingent sediment disturbance had ambiguous effects on the recruitment of hard clams: in the sand flat recruitment tended to be lower (but not significantly) in intense-clam-kicking matrices than in controls, whereas in seagrass recruitment of hard clams did not show a clear response to treatment. In the raking and light-clam-kicking matrices, seagrass biomass fell immediately by 25% below controls but full recovery occurred within a year. In the intense-clam-kicking matrices, seagrass biomass fell by 65% below levels expected from controls; recovery did not begin until more than 2 years passed, and seagrass biomass was still 35% lower than predicted from controls 4 years later. Clam harvest did not affect either the density or species composition of small benthic macroinvertebrates from sediment cores, probably because of their rapid capacity for recolonization and generally short life spans. In all treatments, densities of benthic macroinvertebrates (mostly polychaetes) were substantially higher in the seagrass than in the sand flat during October samplings but equal during March samplings. Bay scallop density declined with declining seagrass biomass across harvest treatments, but the intense-clam-kicking matrices contained even fewer bay scallops than their seagrass biomass would predict, perhaps because of enhanced patchiness of the remaining seagrass. (Author's abstract)
W88-07063

PREDICTION OF WATER RETENTION CHARACTERISTICS FROM SOIL COMPACTION DATA AND ORGANIC MATTER CONTENT,
Maiduguri Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W88-07074

MODEL STUDY OF SOME FACTORS INFLUENCING THE RESATURATION OF SPOIL FOLLOWING MINING AND RECLAMATION,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, and A. S. Crowe.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 121-147, June 30, 1987. 13 fig, 5 tab, 13 ref.

Descriptors: *Groundwater movement, *Strip mines, *Soil water, *Spoil banks, *Coal mining, *Land reclamation, *Recharge, Model studies, Water table fluctuations, Groundwater recharge, Hydraulic conductivity, Drainage, Ponds, Subsurface drainage, Mathematical models, Hills, Simulation.

A two-dimensional, finite-element groundwater flow model was used to study groundwater problems related to the reclamation of coal strip mines. Simulations were carried out on two scales: the mine scale, in which the mine occupies a major portion of the system, and the individual hill scale. In the mine-scale studies the resaturation of the spoil banks is a complex process, depending on the magnitude and distribution of recharge and the hydraulic conductivity of spoil and geological units. Major conclusions from simulations at this scale were as follows: (1) Early in the spoil resaturation process, high gradients can develop along the water table because of spatially distributed recharge (ponds), lack of drainage to units below the mine, and low hydraulic conductivity; (2) When water levels in the spoil rise above those in the units surrounding the mine, the water table ultimately rises to the ground surface across the spoil if high gradient conditions exist or at a relatively limited number of low positions; (3) The rate at which the water table recovers in the spoil is proportional to the magnitude of the recharge rates and lateral inflows from geological units adjacent to the mine. On the hill scale of simulation the following conclusions were reached: (1) Hydraulic conductivity is an important parameter controlling the elevation of the water table within a spoil bank; (2) As the width of the hill increases, the water table rises, and in some cases reaches the ground surface because of increased volumes of water entering the hill along longer slopes and to longer flow paths to the discharge areas. As the height of a hill increases and its slope increases, the potential for the water table to reach the ground surface diminishes; (3) The elevation of the water table is relatively sensitive to the rate of recharge; (4) The presence of local surface discharge areas has a negligible influence on the overall position of the water table; (5) Discrete subsurface drains (tiles) limit the elevation of the water table to only a few meters above the drain. Continuous subsurface drains, comprised of a permeable material, remove water at a much slower rate when the hydraulic conductivity of the drain is only slightly greater than the spoil. (Cassar-PTT)
W88-07111

EFFECTS OF SALINITY AND WATERLOGGING ON THE VEGETATION OF LAKE TOOLIBIN, WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Botany.
R. H. Froend, E. M. Heddle, D. T. Bell, and A. J. McComb.
Australian Journal of Ecology AJECDQ, Vol. 12, No. 3, p 281-298, September 1987. 9 fig, 20 ref.

Descriptors: *Agriculture, *Saline water, *Saline soils, *Waterlogging, *Vegetation effects, *Ephemeral lakes, *Australia, Mortality, Trees, Groundwater level, Soil water, Capillarity, Surface water, Flooding, Aeolian deposits, Fluvial sediments, Soil types, Plant water potential, Waterfowl.

Increased rates of tree senescence and mortality in and adjacent to an ephemeral lake in the Western Australian wheatbelt have been attributed to increased levels of soil salinity and inundation following agricultural clearing. Winter lake salinities approximate freshwater lake values, but during periods when the lake is dry, capillary rise of groundwater is thought to increase surface soil salinity. An undescribed species of Melaleuca and Casuarina obesa dominated the seasonally inundated regions of the lake bed. Aeolian deposits of higher elevation were dominated by Eucalyptus loxophleba, Allocasuarina huegeliana, or species of Banksia. Woodland of E. oleosa var. longicornis and E. salmonophloia occurred predominantly on upland fluviatile deposits of sand and sandy clays. Measurements of soil salinity and the calculation of percentage inundation from tree elevations and observations of tree vigor and xylem pressure potential response indicated that tree deaths in Melaleuca sp. and C. obesa were due to increased levels of salinity. Deaths and low vigor in E. rudis were attributed to both increasing salinities and prolonged inundation. Control of groundwater levels should be a major consideration in the preservation of this ephemeral lake and the waterfowl populations it supports. (Author's abstract)
W88-07168

PROJECTION OF URBANIZATION EFFECTS ON RUNOFF USING CLARK INSTANTANEOUS UNIT HYDROGRAPH PARAMETERS,
Louisville Univ., KY. Dept. of Civil Engineering.
N. R. Bhaskar.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 113-124, February 1988. 3 fig, 9 tab, 12 ref.

Descriptors: *Urban hydrology, *Hydrologic models, *Unit hydrographs, *Urbanization, *Parametric Hydrology, *Watershed models, *Flood forecasting, *Flood hydrographs, Runoff, Simulations, Future planning, Kentucky, Prediction, Management planning.

To alleviate serious flooding problems brought about by rapid urbanization in the Beargrass Creek watershed, Louisville, Kentucky, the U.S. Army Corps of Engineers undertook a major flood study in 1973. To predict flood conditions in 1990, the year when the watershed was expected to undergo complete urbanization, trends in the Clark Instantaneous Unit Hydrograph (Clark IUH) parameters were utilized to determine the 1990 unit hydrograph and flood conditions. Based on the results from this flood study, this paper demonstrates the applicability of using projected Clark IUH parameters for modeling future runoff conditions in an urbanizing watershed. Values of these parameters, as estimated from maximum annual historical flood data, are used to develop regression models for predicting future Clark IUH parameters. Using the projected parameters, selected annual flood events since 1973 are simulated in order to verify the accuracy of these projections. Results show a close correspondence between the simulated and observed flood characteristics. Hence, the use of projected Clark IUH parameters is an appropriate procedure for modeling future runoff conditions in an urbanizing watershed. (Author's abstract)
W88-07284

SOME HYDROLOGIC IMPACTS OF PLOWING RANGELAND SOILS,
Utah State Univ., Logan. Watershed Science Unit.
N. C. Hutten, and G. F. Gifford.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 175-181, February 1988. 10 tab, 19 ref. Utah Agricultural Experiment Station Project 749.

Descriptors: *Soil erosion, *Infiltration rate, *Soil water, *Hydrologic Aspects, *Simulation, *Agricultural hydrology, Agricultural watersheds, Rangelands, Rangeland soils, Statistical analyis, Rainfall simulators, Seasonal variation, Prediction, Utah.

Rainfall simulator studies were conducted during 1982 and 1983 on agricultural and native rangeland soils of the same soil series in northern Utah. Results indicate that the same soil series mapped at different locations on agricultural land will have similar 10, 20, and 30 minute infiltration rates and similar interrill erosion rates. Seasonal differences in infiltration and erosion rates were significant. Comparisons between agricultural and native soils were complicated by three-way statistical interactions. Seasonal variations in both infiltration rates and erosion rates were greatest on agricultural soils. Of four soil series on native rangeland, only one showed significant seasonal variation in infiltration rates, while erosion rates were similar across all seasons for all soil series. Soil and cover factors important in predicting infiltration and erosion were identified. (Author's abstract)
W88-07291

BUSHFIRE HYDROLOGY - THE CASE OF LEAKING WATERSHEDS,
A.C.T Water Authority, G.P.O. Box 863, Canberra City, A.C.T. 2601 (Australia).
For primary bibliographic entry see Field 2A.
W88-07517

SOURCE OF SEEPAGE IN THE SUDAMDIH MINE AREA USING ENVIRONMENTAL ISOTOPES, BIHAR, INDIA,
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W88-07534

LAND-USE CHANGES AND WATER RESOURCES IN A KARSTIC MEDITERRANEAN REGION (EVOLUTION DE L'OCCUPATION DES TERRES ET RESSOURCES EN EAU EN REGION MEDITERRANEENNE KARSTIQUE),
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
S. Rambal.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 339-357, September 15, 1987. 10 fig, 3 tab, 68 ref.

Descriptors: *Soil water, *Soil-water-plant relationships, *Streamflow, *Rainfall, *Land use, *Karst hydrology, *Computer models, Model studies, Hydrology, Vegetation, France.

A computer model, with explicit descriptions for the major processes involved in the transfer of water in the soil-plant system at a local level, formed a basis for simulating the consequences of land-use change on streamflow in a 35 km squared karstic catchment near Montpellier, southern France. Natural vegetation, occupying more than 95% of the total surface, is divided into four types according to the tree cover. In condition of lithologic homogeneity, these types can be used as hydrologic units. Computed streamflow for existing land-use corresponds with recorded data on both the monthly and annual scales. Land-use changes, due to the natural evolution of the vegetation from 1946 to 1979, produced a 80 mm reduction in streamflow for average rainfall conditions. (Author's abstract)
W88-07567

RESPONSE OF INPUT AND OUTPUT OF WATER AND CHLORIDE TO CLEARING FOR AGRICULTURE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
D. R. Williamson, R. A. Stokes, and J. K. Ruprecht.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 1-28, October 15, 1987. 9 fig, 9 tab, 40 ref.

Descriptors: *Water yield, *Rainfall-runoff relationships, *Water pollutions sources, *Agriculture, *Land clearing, *Salinity, *Clear-cutting, *Groundwater recharge, *Streamflow, *Soil water, *Chlorides, Australia, Groundwater, Chemical properties, Transpiration, Catchment areas, Rainfall, Forest clearing, Infiltration, Salt equilibrium.

Five small forested catchments in the Collie River basin in southwest Western Australia were instru-

mented to quantify the changes in input and output of salt and water when land use changed from forest to agriculture. The paired catchment approach was used with two adjacent catchments located in high rainfall (1200 mm/year) and a group of three located in a lower (800 mm/year) rainfall areas. The treatment of complete clearing was applied to one catchment in the high rainfall zone, and to about half of one catchment in the lower rainfall zone after three years of calibration with the uncleared control catchments. Strategies of partial clearing were applied to the third catchment in the lower rainfall zone. The yield of water and salt increased immediately after clearing. In the higher rainfall catchment streamflow increased about four times to about 48% of rainfall, salt load increased to 15 times the mean saltfall (measured as Cl(-)) of 7 g/sq m/yr. Direct runoff increased fourfold to 16% of yearly streamflow, due partly to the increase in the area of soil saturated to the surface. The perched groundwater system was the major source (77% in 1983) of streamflow though it was the route, not the source, of increased salt to the stream. The mottled and pallid clay profile was the major source of salt transported by the deep groundwater system into the perched aquifer. Streamflow became perennial in the first postclearing yr. Absolute increases in streamwater and salt output from partially cleared catchments in the lower rainfall location were about an order of magnitude less than for the higher rainfall catchments though the relative increases were similar. The three catchments were found to be accumulating salt. In the cleared catchments the rising potentiometric surface would establish a saline groundwater discharge zone in the valley and a net export of salt. In all treated catchments reduced interception results in increased water availability at the soil surface for stormflow and infiltration. The reduction in transpiration had an added effect in increasing recharge to groundwater. (Author's abstract)
W88-07568

SOIL WATER DYNAMICS OF LATERITIC CATCHMENTS AS AFFECTED BY FOREST CLEARING FOR PASTURE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, R. J. W. Barron, and D. R. Williamson.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 29-46, October 15, 1987. 10 fig, 5 tab, 13 ref.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Soil water, *Land clearing, *Clear-cutting, *Catchment areas, *Agriculture, *Laterites, *Soil types, *Soil physical properties, *Soil, *Pastures, *Forest clearing, Aquifers, Groundwater recharge, Rainfall, Evapotranspiration, Soil-water-plant relationships, Australia.

Aspects of soil water dynamics as affected by land use changes were examined over a period of 5 years (1974-79) in 2 groups of adjacent catchments located in 1200 mm/yr and 800 mm/yr rainfall zones near Collie, Western Australia. In the summer of 1976/77, after 3 yr of calibration, 100% of one high rainfall catchment, Wights, and 53% of one lower rainfall catchment, Lemon, was cleared of native eucalyptus forest and replaced with pasture. The soil water storage down to 6 m was measured in-situ using a neutron probe in 15 access tubes located at 5 stratified sites in each catchment. Considerable spatial variability in soil water storage was encountered within a site, between sites within a catchment, and between paired catchments; the dominant variability being between sites. Comparisons between the pre-and postclearing states within a catchment and between the cleared and uncleared control catchments were used to evaluate the effect of change in land use on soil water dynamics. Within 2 yrs of the change from forest to pasture, a significant increase in soil water storage had occurred in the profiles in both cleared catchments. Concurrently, there was a small decrease in the uncleared control catchments. The increases following clearing were greater in the higher than in the lower rainfall catchment, more pronounced in the first year than in the second year, and occurred mostly at depths greater than 2 m. In Wights catchment, the increase in summer minimum soil water storage in the first and second years amounted to 220 and 58 mm respectively, while for Lemon catchment the increase for the first year was < 50 mm. This increased soil water storage was due to a substantially lower evapotranspiration from the shallow-rooted, seasonally active pasture which extracts water from the top 1 m or so, compared with the perennial native eucalyptus forest which extracts water from depths down to 6 m and beyond. Due to the relatively low water holding capacity of the surface lateritic soils, the drainage beyond 1 m is substantially increased under pasture, and this results in an increased recharge to the underlying aquifer. (Author's abstract)
W88-07569

EFFECTS OF FOREST CLEARING ON GROUNDWATER,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
A. J. Peck, and D. R. Williamson.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 47-65, October 15, 1987. 7 fig, 2 tab, 29 ref.

Descriptors: *Groundwater quality, *Groundwater level, *Groundwater, *Land clearing, *Aquifers, *Forests, *Surface water, *Groundwater recharge, *Forest clearing, Catchment areas, Agriculture, Chloride, Ions, Salinity, Chemical properties, Hydraulic conductivity, Piezometers, Seasonal distribution.

Groundwater systems were studied in 5 catchments (0.8-3.5 sq km) over 10 yr. At the end of the third year, forest vegetation was totally or partially cleared in three catchments. The cleared areas were sown to pasture or crop. Permanent aquifers were encountered with a deeply weathered regolith derived from igneous basement rocks. In the higher rainfall catchment pair, aquifer boundaries corresponded reasonably well with the surface divide, but permanent aquifers were encountered mainly in lower parts of the three catchments in the medium rainfall area. Slug test measurements of hydraulic conductivity K varied by more than a factor 100 within a catchment, but there was no significant difference between the geometric mean of K in each catchment, which varied between 1.4 and 7.6 mm/day. In the higher rainfall catchments, the potentiometric surface under forest normally responded by 1-4 m after each winter wet season. This indicates significant seasonal recharge. On the basis of the number of piezometers exhibiting this behavior, seasonal recharge was widespread in this area. The seasonal response of the potentiometric surface was rarely more than 1 m under forest in the medium rainfall catchments. At many sites there was no apparent recharge in several years of this study. In areas fully cleared for agriculture, the potentiometric surface moved upward at more than 2.6 m/yr averaged over several years. This was equivalent to increased recharge estimated as 6-12% of rainfall depending on the specific yield used for the aquifer. The potentiometric surface was observed to rise less rapidly (0.9 m/yr) in areas subjected to partial clearing. Groundwater chloride concentrations exhibit no obvious spatial pattern in the catchments. Probability density functions of the chloride data have similar shapes in the higher and medium rainfall catchment areas with median values of 460 and 1000 mg/l respectively. Chloride concentrations were essentially constant with time in some piezometers while in others concentrations varied with or without trend. Recorded changes in time and space are not consistent with the transport equation for solute in an aquifer, leading to the conclusion that local variability of solution velocity may be important. (Author's abstract)
W88-07570

ENVIRONMENTAL ISOTOPE HYDROLOGY OF SALINIZED EXPERIMENTAL CATCHMENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
J. V. Turner, A. Arad, and C. D. Johnson.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 89-107, October 15, 1987. 11 fig, 19 ref.

Descriptors: *Water quality, *Water chemistry, *Land use, *Land clearing, *Salinity, *Isotope tracers, *Groundwater, *Soil water, *Land use, *Rainfall, Chemistry of precipitation, Deuterium, Tritium, Oxygen isotopes, Hydrology, Chloride ions, Catchment areas, Groundwater recharge, Evaporation, Agriculture, Solute concentrations, Western Australia.

Deuterium, oxygen-18, tritium and chloride concentrations were used in 3 salinized experimental catchments to gain insight into the mechanism of solute concentration and flow processes in the saturated and unsaturated zones. The 3 experimental catchments were studied because of their location in different rainfall regions, their status with respect to clearing of native vegetation and with respect to secondary salinization. Two uncleared catchments have average annual rainfalls of approximately 820 and 1220 mm, respectively. The third cleared catchment has an annual rainfall of 650-750 mm. This catchment was in an advanced state of secondary salinization and displayed large areas of saline groundwater discharge with halite encrustation at the ground surface. The stable isotope compositions of the solution phase in solute bulge profiles in the unsaturated zone showed a close agreement with the amount-weighted mean isotopic composition of rainfall and only superficial evidence of isotopic enrichment due to evaporation. Evaporation from the soil surface plays a minor role as a mechanism of solute concentration in the unsaturated zone. The dominant process of solute concentration in the unsaturated zone was ion exclusion during uptake of water by tree roots which was evidently a solute but not isotope fractionating process. Tritium analyses of unsaturated zone water and groundwater indicated movement of recent recharge to 7-10 m depth at the low rainfall site but over the full depth of the 15 m unsaturated zone at the higher rainfall site. The variability in delta O18 and delta H2 values of groundwaters was used in association with chloride concentrations to provide information on mixing characteristics of groundwaters within the catchments. (Author's abstract)
W88-07572

AREAL DISTRIBUTION OF INFILTRATION PARAMETERS AND SOME SOIL PHYSICAL PROPERTIES IN LATERITIC CATCHMENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2G.
W88-07573

MODELS OF THE EFFECT OF CLEARING ON SALT AND WATER EXPORT FROM A SMALL CATCHMENT,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
D. K. Macpherson, and A. J. Peck.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 163-179, October 15, 1987. 4 fig, 1 tab, 20 ref. A.W.R.C. Grant 84/156.

Descriptors: *Water pollution sources, *Clearcutting, *Salinity, *Land use, *Groundwater movement, *Catchment areas, *Model studies, *Streamflow, Chemistry of precipitation, Agriculture, Kalman filter, Solute leaching, Western Australia, Land clearing.

Kalman filtering of 3,981 daily records of streamflow and incomplete daily records of chloride concentration from an experimentally cleared and a control catchment was used to construct daily series of cumulative chloride export. Cross-prediction from the control to the experimental catchment showed highly significant increases in salt and water flows as a result of clearing. The behavior of the coefficients of nonstationary solute leaching models fitted to the increased salt flow suggested that salt outflow is still accelerating, eight years after clearing. Strategies for improved

estimation of catchment dynamics are discussed. (Author's abstract)
W88-07576

PREDICTION OF DELAYS IN GROUNDWATER RESPONSE TO CATCHMENT CLEARING,
Water Authority of Western Australia, P.O. Box 100, Lederville, W.A. (Australia).
G. R. Hookey.
Journal of Hydrology JHYDA7, Vol. 94, No. 1-2, p 181-198, October 15, 1987. 8 fig, 3 tab, 9 ref.

Descriptors: *Catchment areas, *Groundwater movement, *Land clearing, *Subsurface water, *Rainfall intensity, *Recharge, *Forest clearing, *Salinity, *Model studies, Aquifers, Rainfall, Seepage, Hydraulic conductivity.

A two-dimensional groundwater model was applied to areas in the high and low-rainfall regions of a water supply catchment located in the southwest of Western Australia. The response of the underlying aquifer systems to the removal of deep-rooted native vegetation is a function of the temporal pattern of clearing, the proportion of catchment cleared and the location of clearing within the catchment. In terms of the areas modelled, the response in the high-rainfall zone results in immediate groundwater discharge to the surface stream system. In the low-rainfall zone, a delay of some twelve years between the time of clearing and groundwater discharge is predicted. The variation in response times directly influences changes in the salinity of streamflow, as the rising groundwaters intersect and flush salts stored in the soil profile to the surface stream system. The adopted hydrogeological parameters simulate the development of seepage areas and changes in groundwater levels with some accuracy when applied on a catchment-wide basis. Parameter value adopted have included a uniform recharge rate and storage coefficient for each catchment with hydraulic conductivities being varied only marginally. Given the current restrictions on clearing within the water supply catchment, the results indicate that groundwater discharge is almost at equilibrium with recharge in the high-rainfall zone and is around 65% of the final value (expected around 2010) in the low-rainfall zone. (Author's abstract)
W88-07577

PREDICTION OF WATER YIELD REDUCTIONS FOLLOWING A BUSHFIRE IN ASH-MIXED SPECIES EUCALYPT FOREST,
Water Supply Division, Melbourne and Metropolitan Board of Works, Box 4342, Melbourne, Vic. 3001 (Australia).
G. Kuczera.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 215-236, October 30, 1987. 13 fig, 4 tab, 19 ref.

Descriptors: *Water yield, *Streamflow, *Forest fires, *Forests, *Catchment areas, *Water use, *Rainfall-runoff relationships, *Model studies, Trees, Hydrology, Logging, Land clearing, Logging, Bushfires, Melbourne, Australia.

Previous work on long-term yield trends following the 1939 bushfire in mountain ash eucalypt catchments near Melbourne concluded that a relationship exists between the age of the ash forest and average annual streamflow yield. In the light of additional hydrologic and forest data, this study reassesses and extends the earlier work. A two-parameter model of the long-term yield trend following a bushfire is proposed. It is shown to fit rainfall-runoff data for eight catchments affected by the 1939 fires. In addition, the fits confirm earlier findings of significant yield reductions and moreover, suggest possible recovery in yields. Despite insufficient hydrologic data to confirm these recovery trends, forest age and composition data indicate that recovery in yield should be practically complete by the time the ash forest reaches maturity (about 100-150 yr after regeneration). The yield trend model is consistent with this information. Using a generalized least squares approach, regional models for the long-term yield trend parameters L max (the maximum yield reduction) and log K (the response time) are developed. Unlike an earlier regional model only one forest parameter, namely the percentage of 1939 regrowth ash, was found to be significant in the prediction of L max. A simple simulation model based on the regional models is then developed enabling evaluation of the effect of future bushfire (and logging) on catchment yield. This was used to resolve contradictory conclusions about the significance of yield trends in the O'Shannassy catchment where the effect of fires prior to 1939 was shown to obscure the yield trends due to the 1939 fire. In addition, the simulation model was used to illustrate the potential vulnerability of Melbourne's water supply to a major bushfire. (Author's abstract)
W88-07579

RELATIONSHIP OF SOIL SURFACE ROUGHNESS WITH HYDROLOGIC VARIABLES ON NATURAL AND RECLAIMED RANGE LAND IN NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.
C. E. Sanchez, and M. K. Wood.
Journal of Hydrology JHYDA7, Vol. 94, No. 3-4, p 345-354, October 30, 1987. 1 fig, 7 tab, 17 ref.

Descriptors: *Rainfall-runoff relationships, *Land reclamation, *Infiltration, *Soil water, *Soil physical properties, *Runoff, *Land use, Correlation analysis, Mathematical studies, Forests, Agriculture, Range, New Mexico, U.S.A.

Soil surface roughness values have been used to predict runoff and infiltration rates from crop lands, forest lands, and range lands. The strength of association between roughness and runoff and infiltration has been weak as shown with correlation analysis. The purpose of this study was to determine relationships of roughness on the contour to roughness perpendicular to the contour as related to infiltration rates and sediment production on range lands. Roughness up and down slopes (vertical) gave a higher correlation than roughness along the contour (horizontal). Adding or subtracting the vertical and horizontal roughness did not increase correlation values. Highest correlation values resulted from entering vertical and horizontal roughness values into a multiple regression equation. (Author's abstract)
W88-07585

SOIL WATER REGIME DESCRIBED BY A BI-DIMENSIONAL STEADY-STATE FLOW IN A CULTIVATED AND IRRIGATED SOIL, I. THEORY (REGIMES PERMANENTS BIDIMENSIONNELS D'INFILTRATION DANS UN SOL CULTIVE ET MICROIRRIGUE, I. THEORIE.),
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
For primary bibliographic entry see Field 2G.
W88-07586

SOIL WATER REGIME DESCRIBED BY A BI-DIMENSIONAL STEADY-STATE FLOW IN A CULTIVATED AND IRRIGATED SOIL, II. COMPARISON BETWEEN THEORY AND FIELD MEASUREMENTS (REGIMES PERMANENTS BIDIMENSIONNELS D'INFILTRATION DANS UN SOL CULTIVE ET MICROIRRIGUE, II. COMPARAISON DE LA THEORIE AVEC DES MESURES IN-SITU),
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
For primary bibliographic entry see Field 2G.
W88-07587

ENVIRONMENTAL DEGRADATION IN THE PANTANAL ECOSYSTEM,
Laboratorio de Zoologica e Ecologia Animal, Departamento de Biologia Animal, Universidase de Brasilia, Brasilia, DF, 70910, Brazil.
C. J. R. Alho, T. E. Lacher, and H. C. Goncalves.
BioScience BISNAS, Vol. 38, No. 3, p 164-171, March 1988. 4 fig, 4 tab, 50 ref.

Descriptors: *Ecosystems, *Conservation, *Endangered species, *Water foul, *Flood plains, *Wetlands, *Environmental policy, *Water pollution, *Wildlife management, Deforestation, Poaching, Environmental degradation, Pantanal ecosystem, Brazil, Pesticides, Herbicides, Industrial wastes, Economics, Sugar cane, Fields, Alcohols.

The Pantanal floodplain of Brazil, with its extraordinary diversity and abundance of wildlife, is being threatened by human activities. Deforestation, expanding agriculture, illegal hunting and fishing, and pollution of the water with herbicides, pesticides, and by-products of fuel alcohol production have caused a progressive deterioration of the natural environment, placing at risk one of Brazil's most important ecosystems. The Pantanal is the world's largest wetland, being one of the largest breeding grounds for waterfowl. The Pantanal also is one of the last refuges for many of Brazil's threatened or endangered species, such as jaguars, giant anteaters, and swamp deer. The productive waters support an important fisheries industry, and the seasonal grasslands have fed up to 8 million head of cattle. However, there is currently no efficient plan on management for the Pantanal that considers conversation and the social and economic needs of the Brazilian people. In this article the Pantanal ecosystem is described, the causes of environmental degradation are reviewed, and suggestions for effective management in the area are provided. (Brock-PTT)
W88-07671

EMPIRICAL RELATIONSHIPS BETWEEN LAND USE/COVER AND STREAM WATER QUALITY IN AND AGRICULTURAL WATERSHED,
Aquatic Biology Station, Illinois State Natural History Survey, 607 E. Peabody Drive, Champaign, IL 61820, USA.
For primary bibliographic entry see Field 5B.
W88-07711

MEASUREMENT OF RECOVERY IN LAKES FOLLOWING PHOSPHATE MINING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. R. Pratt, J. Cairns, P. M. Stewart, N. B. Pratt, and B. R. Niederlehner.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234498. Price codes: A06 in paper copy, A01 in microfiche. Final Report. Publication No. 03-045-039, February 1985. 117 p, 41 fig, 36 tab, 52 ref, append.

Descriptors: *Lakes, *Ecological effects, *Phosphates, *Mine wastes, *Lake restoration, *Florida, Chemical properties, Alkalinity, Reclamation, Potassium, Organic carbon, Aluminum, Phosphorus, Water quality, Limnology, Lake morphology.

Reclamation of water-filled pits as lakes following surface mining for phosphate ore in Florida is intended to produce fish and wildlife habitat similar to that associated with natural lakes. However, little is known of the rates and equilibrium species numbers for microbial communities that colonize the lakes, the effects of physical and chemical factors on microbial communities, and the rate at which stable physical and chemical factors on microbial communities, and the rate at which stable ecosystems develop. Initial research concentrating on a set of 10 reclaimed, unreclaimed, and natural lakes in central Florida revealed a suite of chemical differences (potassium, hardness, alkalinity, conductivity, and total organic carbon) that could be used to distinguish the lake types, but the protozoan communities could not be similarly differentiated, apparently because their distributions appeared to correlate best with aluminum and phosphorus levels. When the set of lakes was increased to 21 during a supplemental investigation, chemical factors again proved important in distinguishing lake types. Natural, unreclaimed, and active mining pits could be differentiated by their protist communities, but the communities inhabiting the reclaimed lakes spanned the range of variability of all lakes. (Author's abstract)
W88-07758

ENVIRONMENTAL MONITORING AT HANFORD FOR 1986.
Battelle Pacific Northwest Labs., Richland, WA.
Availaboe from the National Technical Information Service, Springfield, VA. 22161, as DE87-011613. Price codes: A10 in paper copy, A01 in microfiche. Report No. PNL-6120, May 1987. 203 p, 65 fig, 22 tab, 66 ref, 7 append. DOE Contract No. DE-AC06-76RLO 1930.

Descriptors: *Environmental protection, *Radioactive wastes, *Monitoring, *Environmental effects, *Hanford, *Washington, Radiation, Radioactivity, Radioactivity effects, Public health, Air pollution, Groundwater pollution.

Surveillance of radioactivity in the Hanford vicinity during 1986 indicated concentrations well below applicable DOE and U.S. EPA standards. Radioactive materials released from Hanford operations were generally dispersed to levels that were indistinguishable above background in the offsite environment. Chemical concentrations in air were below applicable standards established by the EPA and the State of Washington. Chemicals detected in the groundwater beneath the Site can be attributed to both Site operations and natural background levels. Environmental monitoring results from this site, for air, groundwater, surface water, food and farm products, wildlife, soil and vegetation, and penetrating radiation are summarized. The calculated effective dose potentially received by a maximally exposed individual (i.e., the individual who receives the maximum calculated radiation dose using maximum assumptions for all routes of exposure) was about 0.09 mrem for 1986. This is essentially the same as the dose of 0.1 mrem estimated for 1985. The collective effective dose to the population residing within 80 km of the Site was 9 man-rem, the same value estimated for 1985. These doses are much less than the doses received from common sources of radiation, such as natural background radiation. They are also much less than the recently recommended DOE radiation protection standards for protection of the public, which are an average of 100 mrem/yr for prolonged exposure and 500 mrem/yr for occasional annual exposure to a maximally exposed individual. (Lantz-PTT)
W88-07771

GROUNDWATER MANAGEMENT PROBLEMS IN ABANDONED COAL-MINED AQUIFERS: A CASE STUDY OF THE FOREST OF DEAN, ENGLAND,
Bristol Univ. (England). Dept. of Geography.
P. J. Aldous, P. L. Smart, and J. A. Black.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 4, p 375-388, 1986. 8 fig, 3 tab, 23 ref.

Descriptors: *Groundwater management, *Surface-groundwater relations, *Mine drainage, *Path of pollutants, *Aquifers, *Mine wastes, *Mine drainage, *Coal mines, *Water pollution, Boreholes, Tracers, Abandoned mines, England, Water loss, Rivers, Channel linings, Base flow.

An examination was made of groundwater-related problems experienced in the Forest of Dean since abandonment of the major collieries in 1965. Careful planning prior to abandonment of collieries can reduce the number of poor quality discharges, and so substantially limit surface water pollution. Small-scale mining activity continuing after major collieries have been abandoned can have a serious hydrogeological effect by removal of in situ coal from drainage barriers designed to promote free drainage of the mines. In association with the deterioration of lined river channels which retard surface water infiltration, this disruption of subsurface can result in a drainage significant loss of summer base-flow from surface rivers. Two case histories show that safe disposal of wastes to voids in mined Coal Measures aquifers is possible. Prediction of the hydrogeological behavior of the mined aquifer is, however, difficult because of the possibility of unrecorded workings, random collapse and associated ponding, and uncertainty over the hydrological behavior of the coal barriers. Direct investigation of the groundwater flow regime using boreholes and water tracing techniques is recommended. (Author's abstract)
W88-07916

ECOLOGICAL RELATIONSHIPS OF WILD RICE, ZIZANIA AQUATICA: 7. SEDIMENT NUTRIENT DEPLETION FOLLOWING INTRODUCTION OF WILD RICE TO A SHALLOW BOREAL LAKE,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Biology.
T. J. Keenan, and P. F. Lee.
Canadian Journal of Botany CJBOAW, Vol. 66, No. 2, p 236-241, February 1988. 9 fig, 2 tab, 26 ref.

Descriptors: *Rice, *Nutrient removal, *Sedimentation, *Plant growth, *Nitrogen, *Lakes, *Lake sediments, *Minerals, Boreal lakes, Ontario, Discriminant analysis, Zinc, Copper, Magnesium, Potassium, Chemical properties.

A marked decline in wild rice production was observed 5 years after a northwestern Ontario lake was seeded. A paired-comparison t-test determined that sediment manganese, zinc, copper, magnesium, and potassium had all declined in concentration, but nitrogen showed the greatest decrease. Discriminant analysis indicated that sediment nitrogen contributed most to a function distinguishing between years. A controlled experiment using several fertilizer formulations also found that addition of nitrogen to sediment from the lake promoted the greatest increase in wild rice growth. Changes in distribution of wild rice and in values of water depth, organic matter, dry weight of other macrophytes, and wild rice density and dry weight indicated that the decrease in sediment nitrogen was probably associated with movement of wild rice straw within the lake. (Author's abstract)
W88-07946

4D. Watershed Protection

DETERMINING REGIONAL WATER QUALITY PATTERNS AND THEIR ECOLOGICAL RELATIONSHIPS,
Regional Air Pollution Control Agency, PO Box 972, Dayton, OH 45422.
For primary bibliographic entry see Field 7C.
W88-06967

INFLUENCE OF SMALL MAMMALS ON STORMFLOW RESPONSES OF PINE-COVERED CATCHMENTS,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
S. J. Ursic, and R. J. Esher.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 133-139, February 1988. 3 fig, 4 tab, 27 ref.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Pine trees, *Mammals, *Storm runoff, *Catchment areas, *Forest hydrology, *Forest watersheds, Detention, Retention, Mammals, Rainfall penetration, Mississippi.

The relative abundance of small mammals in five forest land cover types on the upper Coastal Plain of north Mississippi was determined. Burrowing mammals accounted for one-half of the total captures; one shrew species that accounted for over one-fourth of the total captures had a strong affinity for well-stocked pine plantations. The opportunity for detention and retention of rainfall was enhanced by burrowing activity. Reductions of stormflow volumes 12 to 15 years after replacing poor quality, upland hardwoods with loblolly pine were only partially explained by increased interception of rainfall; much of the residual reductions are postulated to be due to small mammal burrows. Small mammal activity deserves further study as an important aspect of forest land hydrology. (Author's abstract)
W88-07286

REMOTE SENSING SCIENCE APPLICATIONS IN ARID ENVIRONMENTS,
Nevada Univ., Reno. Dept. of Range, Wildlife and Forestry.
For primary bibliographic entry see Field 7B.
W88-07658

HYDROLOGIC ENGINEERING CENTER'S ACTIVITIES IN WATERSHED MODELING,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2A.
W88-07740

EROSION AND SEDIMENT YIELD: SOME METHODS OF MEASUREMENT AND MODELLING.
For primary bibliographic entry see Field 2J.
W88-07895

RESERVOIR TRAP EFFICIENCY,
Agricultural Research Service, Beltsville, MD. Hydrograph Lab.
For primary bibliographic entry see Field 8A.
W88-07903

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

ENRICHMENT OF ARSENIC AND ITS SEPARATION FROM OTHER ELEMENTS BY LIQUID-PHASE POLYMER-BASED RETENTION,
Vernadsky Inst. of Geochemistry and Analytical Chem., Acad. of Sciences, Moscow 117975, USSR.
V. M. Shkinev, G. A. Vorob'eva, B. Y. Spivakov, K. E. Geckeler, and E. Bayer.
Separation Science and Technology SSTEDS, Vol. 22, No. 11, p 2165-2173, November 1987. 5 fig, 10 ref.

Descriptors: *Arsenic, *Water analysis, *Chemical analysis, *Wastewater treatment, *Separation techniques, *Heavy metals, *Polymers, *Reagents, *Membrane filters, *Cations, Copper, Cadmium, Zinc, Enrichment, Cobalt, Hydrogen ion concentration.

Preconcentration and recovery of arsenic from diluted aqueous solutions by soluble polymeric reagents in combination with membrane filtration were investigated. Quaternized poly(ethyleneimine) was found to be an efficient reagent for removal of arsenic and for separation of As(III), As(V), and divalent metal cations such as Cu, Cd, Zn, and Co. Using a 4% solution of the polymer reagent, 98% of arsenic(V) was retained at pH 8.5, which could be stripped off by addition of a 0.15 M solution of a sodium salt solution at the same pH. A practical application was demonstrated by the removal of more than 95% of As(V) from actual concentrations of arsenic in wastewater. (Author's abstract)
W88-06840

SPECIFIC IDENTIFICATION OF SYNTHETIC ORGANIC CHEMICALS IN RIVER WATER USING LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION COUPLED WITH ELECTRON IMPACT, CHEMICAL IONIZATION AND ACCURATE MASS MEASUREMENT GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
A. M. Dietrich, D. S. Millington, and Y.-H. Seo.
Journal of Chromatography JOCRAM, Vol. 436, No. 2, p 229-241, February 5, 1988. 5 fig, 3 tab, 26 ref. WRRI Project No. A-127-NC.

Descriptors: *Pesticides, *Pollutant identification, *Organic compounds, *Riparian waters, *Chemical wastes, *Extraction, *Adsorption, *Ionization, *Mass spectrometry, *Gas chromatography, *Chemical analysis, Chemical composition, Quanti-

tative analysis, Herbicides, Phosphates, Haw River, North Carolina.

Capillary column gas chromatography-mass spectrometry, utilizing electron impact, chemical ionization and accurate mass determinations, was applied to the broad spectrum analysis of synthetic organic chemicals (SOCs) in the Haw River, in the North Carolina Piedmont. The river was sampled at three locations several times during a thirteen-month period. The SOCs were isolated by either resin adsorption or direct methylene chloride liquid-liquid extraction. Of the 48 distinct SOCs detected, those found most frequently included atrazine and methyl atraton (triazine herbicides), dimethyl dioxane, 1,2,4-trichlorobenzene, tributylphosphate, triethylphosphate, trimethylindolinone, and tris(chloropropyl)phosphate. Many of these chemicals are indigenous to industrial and agricultural activities in the Piedmont. Concentrations of the SOCs were in the ng/L to microgram/L range. The qualitative and quantitative data were similar for both extraction methods, but the resin method was more tedious and introduced more artifacts. (Author's abstract)
W88-06844

TRACE METAL CONCENTRATIONS IN MUSSELS: COMPARISON BETWEEN ESTUARINE, COASTAL AND OFFSHORE REGIONS IN THE SOUTHEASTERN NORTH SEA FROM 1983 TO 1986,
Institut fur Hydrobiologie und Fischereiwissenschaft, Zeiseweg 9, D-2000 Hamburg 50, Federal Republic of Germany.
T. Borchardt, S. Burchert, H. Hablizel, L. Karbe, and R. Zeitner.
Marine Ecology Progress Series MESEDT, Vol. 42, No. 1, p 17-31, January 4, 1988. 10 fig, 3 tab, 33 ref.

Descriptors: *Bioindicators, *Trace elements, *Heavy metals, *Pollutant identification, *Mussels, *Path of pollutants, *Coastal waters, *Trace metals, *Estuarine environment, Trace metals, Sea water, Estuaries, North Sea, Pollutants, Heavy metals, Mytilus, Mollusks, Bioindicators, Bioaccumulation, Monitoring, Comparison studies, Distribution patterns, Regression analysis, Mercury cadmuim, Copper, Silver, Lead, Oxygen deficit.

The blue mussel Mytilus edulis was used for monitoring trace metal contamination in the southeastern North Sea. From 1983 to 1986 more than 200 samples were collected from natural and cultured mussel beds, from groynes, anchor chains of nautical buoys and from biological monitoring stations. Soft bodies were analyzed for Hg, Cd, Cu, Ag and Pb by atomic absorption spectrophotometry. Metal concentrations in mussels from the estuaries of Ems, Jade and Elbe were compared with those from the inner German Bight, from a region off southern Jylland, and the open sea. In some cases, M. edulis from offshore areas contained metal concentrations as high as specimens from the estuaries. Cd and Pb concentrations increased from the inner German Bight toward the central North Sea. Using multiple regression analysis, a standard mussel was defined. For each region, normalized metal concentrations could be calculated. This approach provides a more realistic impression regarding contamination levels than using measured concentrations. Trace metal levels in mussels are influenced by season, size and body condition. For some regions temporal, mostly decreasing, trends in metal concentrations could be detected. It is suggested that the unexpected high cd and Pb levels in mussels from the central North Sea are due to: (1) changes in trace metal speciation (increased bioavailability counteracts declining concentrations in seawater toward the open sea); (2) the pattern of residual currents (most of the pollutants brought into the sea around the British Isles settles and accumulates in the central North Sea); (3) oxygen deficiencies (in certain regions this leads to pronounced changes in redox conditions in sediments, allowing remobilization). (Author's abstract)
W88-06862

DISSOLVED ORGANIC CARBON IN STREAMS AND GROUNDWATER,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W88-06902

WATER QUALITY STUDIES ON BUCKINGHAM CANAL (MADRAS, INDIA)--A DISCRIMINANT ANALYSIS,
Presidency Coll., Madras (India). Dept. of Zoology.
S. Ravichandran.
Hydrobiologia HYDRB8, Vol. 154, p 121-126, November 16, 1987. 7 tab, 14 ref.

Descriptors: *Pollutant identification, *Network design, *Monitoring, *Water quality, *Discriminant analysis, Buckingham Canal, Madras, India, Data interpretation, Statistical analysis, Phytoplankton, Coliforms, Zooplanton, Streptococcus, Primary productivity.

Multiple discriminant analysis was applied to data collected during two years of water quality monitoring at five stations at the Buckingham Canal at Madras, India. Variables were divided into three groups: physical and chemical, pollutants, and biological. The biological variables correctly indicated water quality in 81.66% of the samples, whereas the physical and chemical variables were 46.66% correct and the pollutants, 48.33%. The biological variables included in the analysis were chlorophyll a, gross primary production, gross production/net production ratio, biomass, total coliforms, fecal coliforms, fecal streptococci, total coliforms/fecal coliforms ratio, fecal coliforms/fecal streptococci ratio, phytoplankton diversity, phytoplankton evenness, zooplankton diversity, and zooplankton evenness. (Cassar-PTT)
W88-06906

BIOLOGICAL CHARACTERIZATION OF SEDIMENTS BY STANDARDIZED TUBIFICID BIOASSAYS,
Department of Zoology, Upsala University, Sweden.
G. Milbrink.
Hydrobiologia HYDRB8, Vol. 155, p 267-275, December 15, 1987. 4 fig, 2 tab, 12 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Sediments, *Heavy metals, *Tubificids, Oligochaetes, Indicators, Bioassay, Lake sediments, Metals, Mercury, Copper, Zinc, Invertebrates, Mine wastes, Aquatic habitats, Habitats, Benthic invertebrates.

Tubifex tubifex were used in the development of a bioassay method for assessing environmental pollution with heavy metals in sediments. Tubificids were exposed to sediments from oligotrophic Lake Runn (Sweden) which received mining wastes. These sediments (dry weight basis) contained 800-3600 ng/g mercury, 800-1800 microgram/g copper, and 3.3-8.1 mg/g zinc. The tubificids grew poorly and did not reproduce. All had died by 200 days of exposure. Reproduction did occur when Lake Runn sediments were diluted with sediments from the eutrophic Lake Hjalmaren, so that the Lake Runn proportion was less than 50%. The growth rate, reproductive success, and the timing of consecutive reproductive events of cohort individuals were highly indicative of toxic effects. However, the presence of extra food masked the effects. Therefore, extra food rations were excluded from the method. (Cassar-PTT)
W88-06908

QUALITATIVE AND QUANTITATIVE ANALYSES OF PETROLEUM HYDROCARBON CONCENTRATIONS IN A TROUT STREAM CONTAMINATED BY AN AVIATION KEROSENE SPILL,
Pittsburgh Univ., PA. Graduate School of Public Health.
P. D. Guiney, J. L. Sykora, and G. Keleti.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 2, p 105-114, February 1987. 5 fig, 2 tab, 12 ref. Laurel Pipe Line Co. Contract CC-82-3.

Descriptors: *Hydrocarbons, *Fate of Pollutants, *Oil spills, *Kerosene, *Pipelines, *Sediment-water interfaces, *Oil pollution, Skimming, Bottom sediments, Secondary oil recovery, On-site investigations, Detection limits, Quality control, Gas chromatography, Tissue analysis, Pollutants.

Kerosene-range hydrocarbons were monitored in a small central Pennsylvania stream watershed, over two years (1982 to 1984), after a pipeline leak of about 1,310 barrels of aviation kerosene. This study, part of a two-phased program, was designed to detect and quantify hydrocarbon concentrations in freshwater environmental compartments impacted by the spill. Various methods of analysis were employed. Field conditions required careful documentation of methodologies and quality assurance practices for sample collection and analysis to ensure the validity of results. The concentration of kerosene-range hydrocarbons and total organic carbon in the contaminated stream water typically decreased during the initial months after the spill and generally remained at or below background levels after 3 months. Elevated concentrations of hydrocarbons, however, were detected in sediment samples and tissues of fish collected from two impacted bridge locations up to 14 months after the spill occurred. These two bridges were primary boom recovery sites during spill cleanup activities. Bottom sediments from pools near these sites contained approximately two to three times the corresponding hydrocarbon concentrations detected in fish tissues from the same area. This information appears to suggest that these surface sediments may have served as secondary storage sinks for residual, sinking product not recovered during the initial skimming operations. These residues were apparently available for uptake by resident fish. No kerosene-range hydrocarbons were detected in these surface sediments after 21 months, and other stream water quality parameters remained within normal limits. Fused-silica capillary gas chromatography appeared to offer high resolution and precision and provided reasonable detection limits for analyzing kerosene-range hydrocarbons in the contaminated environmental compartments investigated in this study. (Author's abstract)
W88-06927

SENSITIVITY ANALYSIS OF POPULATION GROWTH RATES ESTIMATED FROM CLADOCERAN CHRONIC TOXICITY TESTS,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5C.
W88-06928

DETERMINATION OF UPTAKE RATE CONSTANTS FOR SIX ORGANOCHLORINES IN MIDGE LARVAE,
Ohio State Univ., Columbus. Dept. of Entomology.
For primary bibliographic entry see Field 5B.
W88-06930

COMPARISONS OF LABORATORY TOXICITY TEST RESULTS WITH RESPONSES OF ESTUARINE ANIMALS EXPOSED TO FENTHION IN THE FIELD,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W88-06931

FIELD VALIDATION OF AVOIDANCE OF ELEVATED METALS BY FATHEAD MINNOWS (PIMEPHALES PROMELAS) FOLLOWING IN SITU ACCLIMATION,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W88-06934

ACCLIMATION TO CADMIUM TOXICITY BY WHITE SUCKERS: CADMIUM BINDING CAPACITY AND METAL DISTRIBUTION IN GILL AND LIVER CYTOSOL,
Department of Fisheries and Oceans, Winnipeg

(Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W88-06939

USE OF RESPIRATORY-CARDIOVASCULAR RESPONSES OF RAINBOW TROUT (SALMO GAIRDNERI) IN IDENTIFYING ACUTE TOXICITY SYNDROME IN FISH: PART 1. PENTACHLOROPHENOL, 2,4-DINITROPHENOL, TRICAINE METHANESULFONATE AND 1-OCTANOL,
Environmental Research Lab., Duluth, MN.
J. M. McKim, P. K. Schmieder, R. W. Carlson, E. P. Hunt, and G. J. Niemi.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 295-312, April 1987. 5 fig, 4 tab, 86 ref.

Descriptors: *Bioindicates, *Monitoring, *Fish physiology, *Respiration, *Trout, *Toxicity, *Water pollution effects, *Organic compounds, *Population exposure, Uncouplers, Morbidity, Oxygen uptake, Oxidative phosphorylation, Hypoxia, Model studies, Fish, Narcotics.

An in vivo fish model was adapted to monitor respiratory-cardiovascular responses of spinally transected rainbow trout exposed to acutely toxic aqueous concentrations of two uncouplers of oxidative phosphorylation, pentachorophenol (PCP) and 2,4-dinitrophenol (DNP), and two narcotics, tricaine methanesulfonate (MS-222) and 1-octanol. The most evident toxic response to the uncouplers was a rapid 150 to 200% increase in ventilation volume (V sub G) and oxygen consumption (VO2) over the entire survival period. This caused an initial increase in total arterial oxygen (TaO2) content of the blood, which then fell slowly. Arterial blood pressure (BPa) and other blood measurements did not change appreciably in response to PCP, yet DNP caused increases in hematocrit (Hct) and hemoglobin (Hb) and slight decreases in total arterial carbon dioxide (TaCO2) and arterial pH (pHa). In contrast to the uncouplers, the response to toxic levels of narcotics was a dramatic slowing of all respiratory-cardiovascular functions. While V sub G and VO2 decreased 40 to 50% from predose levels, oxygen utilization (U) increased 20 to 30%. Ventilation rate (VR) declined initially and then increased slowly until death occurred, but remained within the control range. As respiration declined TaO2 significantly decreased, as did pHa. In response to hypoxia, Hct increased substantially, and Hb increased slightly only in the 1-octanol exposure. A rapid 40 to 50% drop in heart rate (reflex bradycardia) was also observed. The final phase of toxicity caused by both inducers eventually produced acute tissue hypoxia, a generalized loss of respiratory-cardiovascular coordination, and finally respiratory paralysis. (See also W88-06942) (Author's abstract)
W88-06941

ROOT ELONGATION METHOD FOR TOXICITY TESTING OF ORGANIC AND INORGANIC POLLUTANTS,
Illinois State Water Survey Div., Peoria. Water Quality Section.
W. Wang.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 5, p 409-414, May 1987. 3 fig, 3 tab, 17 ref. EPA Contract R810834.

Descriptors: *Bioassay, *Vegetable crops, *Heavy metals, Cadmium, Copper, Nickel, Zinc, Toxicity, Statistical analysis, Hazardous materials, Water pollution effects, Water quality, Plant pathology.

Millet is a riverine species widely distributed in the Midwest. The Illinois State Water Survey has conducted several studies using this species and the results show the millet to be rather promising for toxicity testing. The objective of the present study was to compare the responses of lettuce, cucumber and millet seeds to heavy metals, including Cd, Cr(VI), Cu, Mn, Ni and Zn. Lettuce was most sensitive to metal toxicity, while results for cucumber and millet were mixed. The millet seeds, however, did show a predictable pattern of response similar to their response to phenolic toxicity. There was a fairly good correlation between 50% effect concentrations and no observed effect concentrations for millet (R squared = 0.858.) Lettuce and millet seeds are recommended for use together in toxicity tests of unknown, complex hazardous substances. (Author's abstract)
W88-06947

EVALUATION OF THE RELATIVE SENSITIVITIES OF 7-D DAPHNIA MAGNA AND CERIODAPHNIA DUBIA TOXICITY TESTS FOR CADMIUM AND SODIUM PENTACHLOROPHENATE,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 2, p 153-159, February 1988. 1 fig, 11 tab, 19 ref. US EPA cooperative agreement CR-812361-01-0.

Descriptors: *Toxicity, *Pesticide toxicity, *Bioassay, *Daphnia, *Cadmium, *Sodium compounds, Morbidity, Fertility.

A comparison of the results of 7-d Daphnia magna and Ceriodaphnia dubia toxicity tests indicated that the two species were equally sensitive to sodium pentachlorophenate (PCP) but that C. dubia was more sensitive to cadmium. The most sensitive chronic endpoint varied with species and test chemical. The most sensitive index of cadmium stress in D. magna was body length of primiparous females, whereas in C. dubia it was total young produced per female. For both D. magna and C. dubia, reproductive indices were more sensitive indicators of PCP stress than was survival. The results of this study, along with data from the literature, suggest that C. dubia is as, or more, sensitive to inorganic and organic chemicals than is D. magna, and that, if the indices of toxicity are carefully chosen, 7-d tests may provide estimates of no-effect concentrations that are as low as those generated in tests of longer duration. (Author's abstract)
W88-06956

DETERMINATION OF DOSE-TIME-RESPONSE RELATIONSHIPS FROM LONG-TERM ACUTE TOXICITY TEST DATA,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
W. Hong, P. G. Meier, and R. A. Deininger.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 3, p 221-226, March 1988. 2 fig, 1 tab, 15 ref.

Descriptors: *Dose-response relationships, *Bioassay, *Toxicity, *Computer programs, Data processing, Mathematical models, Time series analysis, Pesticide toxicity, Minnows.

Long-term exposures over 96 h provide valuable information on the behavior of toxic chemicals that cannot be obtained from short-term tests. Time-dependent LC50 and dose-time-response plots are important in evaluating the toxicity of chemical compounds to test organisms. However, their use is limited because of cumbersome calculations. To circumvent this, a BASIC program was developed that is based on the multivariate linear model theory. The main program, MULTILC, runs on an IBM PC and generates an equation that describes dose-time-response relationships. From this equation, time-dependent LC50 values and their 95% confidence intervals are calculated. In addition, the subprogram, 3DGRPH, draws a series of plots on the computer screen, including a three-dimensional dose-time-response surface. The application of the program is illustrated using two 14=d continuous flow toxicity test of diquat for fathead minnows. (Freeman-PTT)
W88-06960

VIRUSES IN SEWAGE WATERS DURING AND AFTER A POLIOMYELITIS OUTBREAK AND SUBSEQUENT NATIONWIDE ORAL POLIOVIRUS VACCINATION CAMPAIGN IN FINLAND,
Enterovirus Lab., Dept. of Virology, National Public Health Inst., Helsinki, Finland.
For primary bibliographic entry see Field 5B.
W88-07007

ISOLATION OF FECAL COLIFORMS FROM PRISTINE SITES IN A TROPICAL RAIN FOREST,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-07013

STRUCTURE-FUNCTION RELATIONSHIPS FOR MONITORING CELLULAR STRESS AND RECOVERY RESPONSES WITH SELENASTRUM CAPRICORNUTUM,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P.-A. Thompson, P. Couture, C. Thellen, and J.-C. Auclair.
Aquatic Toxicology AQTODG, Vol. 10, No. 5/6, p 291-305, August 1987. 1 fig, 4 tab, 42 ref. Environment Canada UP-1ST83-00313 and NSERC Canada Grant A8123.

Descriptors: *Bioindicator, *Cadmium, *Industrial wastewater, *Recovery response, *Water pollution effects, *Population exposure, *Toxicity, *Microbiological studies, *Selenastrum, Prediction, Photosynthesis, Effluents, Bioindicators, Stress.

Recovery responses to toxicants are often neglected in screening and hazard assessment studies which use primary producers as test microorganisms. Both structural and functional biotic variables of Selenastrum capricornutum populations are proposed to diagnose cellular stress and predict recovery responses. Industrial effluent from a chlor-alkali plant had greater short-term effects on both photosynthetic efficiency (P/B ratio) and adenylate energy charge (EC sub A) than did cadmium. With both toxicants high P/B ratios and EC sub A were observed at the end of the experiment when cell densities are still low, suggesting that these functional parameters can be useful in the detection of recovery responses to toxicants. EC sub A appears to remain low only under conditions of acute stress. The variation of ATP/cell during the 96 h of exposure is proposed as an indicator for predicting short-term recovery in hazard assessment studies. (Author's abstract)
W88-07031

INVESTIGATION OF LEGIONELLA PNEUMOPHILA IN DRINKING WATER,
Groundwater Management and Supply Branch, USEPA, John F. Kennedy Federal Building, Boston, MA 02203.
For primary bibliographic entry see Field 5F.
W88-07041

SOME EFFECTS OF METAL SALTS AND ACID PRECIPITATION ON THE FRESHWATER TRICLAD POLYCELIS FELINA (DALYELL),
Dept. of Life Sciences, Trent Polytechnic, Nottingham, U.K.
For primary bibliographic entry see Field 5C.
W88-07050

DETERMINATION OF PARAQUAT BY FLOW-INJECTION SPECTROPHOTOMETRY,
Department of Analytical Chemistry, Faculty of Chemistry, Complutense University of Madrid, 28040 Madrid (Spain).
E. C. Guijarro, P. Yanez-Sedeno, and L. M. Polo-Diez.
Analytica Chimica Acta ACACAM, Vol. 199, p 203-208, August 15, 1987. 2 fig, 3 tab, 17 ref.

Descriptors: *Water analysis, *Paraquat, *Diquat, *Herbicides, *Pesticides, *Flow-injection spectrophotometry, Spain, Potable water, Polarographic analysis, Potatoes, Spectrophotometry.

The flow-injection determination of Paraquat (1,1'-dimethyl-4,4'-bipyridinium) is based on its reduction with sodium dithionate in alkaline medium and detection at 665 nm. Linear calibration plots obtained for 0.1-1.0, 1.0-10 and 5.0-30.0 mg/l Para-

quat, the lower limit being 40 times less than that of the usual spectrophotometric method. The method is applied to determine Paraquat in spiked potable water and potatoes after preconcentration by column ion-exchange. The determination of Paraquat in different herbicide samples yielded results in good agreement with those obtained by polarographic and manual spectrophotometric methods. (Author's abstract)
W88-07120

COPRECIPITATION OF AN ORGANOPHOSPHATE FRACTION FROM HARBOR WATER FOR X-RAY FLUORESCENCE SPECTROPHOTOMETRY,
Sydney Univ. (Australia). Dept. of Inorganic Chemistry.
F. Ahern, J. M. Eckert, S. F. Hain, K. E. A. Leggett, and N. C. Payne.
Analytica Chimica Acta ACACAM, Vol 199, p 259-263, August 15, 1987. 2 tab, 9 ref.

Descriptors: *Water analysis, *Chemical analysis, *Coprecipitation, *Organophosphorus compounds, *Biological organophosphate, *X-ray fluorescence spectrometry, *Cobalt pyrrolidinemedithiocarbamate carrier complex, Phosphorus, Seawater, Trace metals, Harbor water.

The film x-ray fluorescence spectrum of a cobalt pyrrolidinedithiocarbamate carrier complex, precipitated in harbor water samples, contains a previously unreported peak at the wavelength of the first-order Ko line of phosphorus. The coprecipitated phosphorus is an organophosphate fraction of biological origin, constituting approximately 10% of the dissolved organophosphorus in the waters. (Author's abstract)
W88-07122

SOME PROBLEMS ASSOCIATED WITH BREWERY AND DAIRY WATER DISCHARGES,
Science College, Mosul University, Mosul, Iraq.
For primary bibliographic entry see Field 5C.
W88-07124

COLIFORM BACTERIAL COUNTS IN THE NILE WATER AT KHARTOUM,
Khartoum Univ. (Sudan). Faculty of Agriculture.
For primary bibliographic entry see Field 5B.
W88-07125

SULFATE IN COLORED WATERS: II. EVALUATION OF APPROACHES FOR CORRECTING HISTORICAL COLORIMETRIC DATA,
National Water Research Inst., Burlington (Ontario). Analytical Methods Div.
For primary bibliographic entry see Field 7A.
W88-07131

COAGULATION AND ADSORPTION OF HUMIC SUBSTANCES: AN ANALYSIS OF SURROGATE PARAMETERS FOR PREDICTING EFFECTS OF TRIHALOMETHANE FORMATION POTENTIAL,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5F.
W88-07133

ASSESSMENT OF METAL SPECIES BIOAVAILABILITY AND GEOCHEMICAL MOBILITY IN POLLUTED WATERS,
Department of Engineering, Chalmers University of Technology, S-412 96 Goteborg, Sweden.
G. M. P. Morrison, and D. M. Revitt.
Environmental Technology Letters ETLEDB, Vol. 8, No. 8, p 361-372, August 1987. 4 fig, 2 tab, 31 ref.

Descriptors: *Chemical analysis, *Water pollution, *Path of pollutants, *Metals, *Heavy metals, *Lead, *Geochemical mobility, *Bioavailability, *Sweden, *France, *Acid rain, Metal transport, Trace metals, Gullypot, Dialysis, Fractionation, Water analysis.

Metal speciation methods which identify potentially bioavailable and/or geochemically mobile metal fractions in polluted waters are discussed. Two approaches to monitoring bioavailable metal are: (1) a comparison between chelex removable metal concentrations and water quality standards and (2) the determination of bioavailable metal uptake rates by a dialysis with receiving resins technique. Metal species mobilization and transport processes through a gullypot system have been identified by the application of a physico-chemical speciation scheme. The transfer of metal species between phases and fractions is affected by acid rain mobilization, free and weakly complexed metal ion reaction, pH/surface area dependent suspended solid metal transport and gullypot sediment maturation. (Author's abstract)
W88-07139

METAL SPECIATION VARIATIONS WITHIN SEPARATE STORMWATER SYSTEMS,
Urban Pollution Research Centre, Middlesex Polytechnic, Queensway, Enfield, Middlesex, England EN3 4SF.
For primary bibliographic entry see Field 5B.
W88-07140

BIOAVAILABLE METAL UPTAKE RATE DETERMINATION IN POLLUTED WATERS BY DIALYSIS WITH RECEIVING RESINS,
Department of Sanitary Engineering, Chalmers University of Technology, S-412 96 Goteborg, Sweden.
G. M. P. Morrison.
Environmental Technology Letters ETLEDB, Vol. 8, No. 8, p 393-402, August 1987. 2 tab, 23 ref.

Descriptors: *Storm water, *Metals, *Bioavailability, *Heavy metals, *Zinc, *Cadmium, *Lead, *Copper, Dialysis, Sweden, Water pollution, Receiving resins dialysis, Outfall, Effluents, Speciation.

Dialysis with receiving resins has been devised for the determination of bioavailable metal uptake rate in polluted waters. This speciation technique responds to bioavailable metal species by incorporating a metal chelating resin contained within a dialysis membrane. The values obtained are expressed in terms of a metal uptake rate per unit surface area and time. Mean efficiencies for the reduction of bioavailable uptake rates, between the influent and effluent of a sewage treatment plant, have been derived for Zn (42%), Pb (49%) and Cu (33%). Background receiving resin uptake rates, from an unpolluted stretch of river, for Zn, Cd, Pb and Cu were exceeded at three monitored stormwater outfalls which provided a range of receiving resin uptake rates for Zn, Cd, Pb and Cu. (Author's abstract)
W88-07142

ZERO-DEPOSITION TIME EXTRAPOLATION DPASV FOR DETERMINATION OF THE COMPLEXATION CAPACITY,
Dept of Geography, Peking University, Beijing, People's Republic of China.
S. Tao, J. S. Chen, and F. Tang.
Environmental Technology Letters ETLEDB, Vol. 8, No. 9, p 433-440, September 1987. 1 fig, 5 tab, 20 ref.

Descriptors: *Heavy metals, *Water analysis, *Path of pollutants, *Copper, *Lead, *Cadmium, *Humic acids, *Trace metals, *Metals, *Speciation, Natural waters, Differential equations, Titration, *Complexation, China, Statistical analysis.

The complexation capacities of an EDTA and a humic acid solution for copper, cadmium and lead were repeatedly measured by a DPASV titration procedure using different deposition times. The determined complexation capacities were negatively correlated to the deposition time, which could be described using empirical equations. The true values of the complexation capacities were then calculated by extrapolating the deposition time to zero. The procedure was applied to a fresh water sample from Pond Weiming, Beijing and gave a complexation capacity of 4.3 micromol/l for Cu and Pb. This value is higher than that previously reported for natural fresh waters because both the labile and non-labile complexes are included in the results obtained by the zero-deposition time technique. (Author's abstract)
W88-07146

CONSTRUCTION AND EXPLOITATION OF AN AUTOMATIC SEQUENTIAL WET-ONLY RAIN SAMPLER,
Laboratoire de physico-chimie de l'atmosphere, Universite Paris 7, 2 Place Jussieu, 75251, Paris Cedex 05, France.
For primary bibliographic entry see Field 5B.
W88-07150

ACID DROPS PROJECT: POLLUTION MONITORING BY YOUNG PEOPLE,
Field Studies Council, Epping Forest Conservation Centre, High Beach, Loughton, Essex IG10 4AF.
For primary bibliographic entry see Field 2K.
W88-07155

QUANTITATIVE DETERMINATION OF ARSENOCHOLINE AND ACETYLARSENOCHOLINE IN AQUATIC ORGANISMS USING PYROLYSIS AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
National Inst. of Environmental Medicine, Stockholm (Sweden).
For primary bibliographic entry see Field 5B.
W88-07179

COMPOSITION AND STRUCTURE OF REVERSE OSMOSIS FOULANT DEPOSITS FORMED FROM RAND WATER BOARD WATER: A PRELIMINARY INVESTIGATION,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5F.
W88-07228

RESIDUES OF ORGANOCHLORINE PESTICIDES IN FISH FROM THE ARABIAN GULF,
Department of Environmental Marine Chemistry, Marine Science Centre, The University, Basrah, Iraq.
For primary bibliographic entry see Field 5B.
W88-07270

DETERMINING ULTRATRACE METAL CONCENTRATIONS BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROMETRY,
Oakland Univ., Rochester, MI. Dept. of Chemistry.
T. Malinski, J. Fish, and H. Matusiewicz.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 81-85, March 1988. 2 fig, 2 tab, 33 ref.

Descriptors: *Water analysis, *Spectroscopy, *Trace metals, *Trace levels, *Chemical analysis, *Inductively coupled plasma atomic emission spectroscopy, Cadmium, Copper, Cobalt, Chromium, Manganese, Nickel, Lead, Zinc.

The use of electrothermal vaporization devices (ETV) to introduce analytes into inductively coupled plasma (ICP) for determination by atomic emission spectroscopy (AES) provides detection limits in picograms but requires solution concentrations higher than nanogram-per-liter levels. Determination of metal concentrations lower than nanograms per liter requires a preconcentration step. The method of controlled potential electrodeposition of metals into mercury film on glassy carbon electrodes for ETV-ICP-AES can be used for simultaneous multielemental determination of trace and ultratrace concentrations of metals in water. Modification and optimization of the technique are discussed. Also included are the results of determinations of eight trace elements (Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn). (Author's abstract)
W88-07384

MODIFIED M-CP MEDIUM FOR ENUMERATING CLOSTRIDIUM PERFRINGENS FROM WATER SAMPLES,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
R. Armon, and P. Payment.
Canadian Journal of Microbiology CJMIAZ, Vol. 34, No. 1, p 78-79, January 1988. 2 tab, 7 ref.

Descriptors: *Bacterial analysis, *Clostridium perfringens.

Medium m-CP, designed for the isolation of Clostridium perfringens from water samples, contains indoxyl beta-D-glucoside, an expensive chemical that is present at a high concentration in this medium. The use of m-CP with three concentrations of indoxyl beta-D-glucoside was tested at 0, 60, and 600 mg/L. Lowering the amount of indoxyl beta-D-glucoside to 60 mg/L (1/10 the recommended concentration) reduced the cost of this medium without affecting its sensitivity. (Author's abstract)
W88-07414

RAPID DETERMINATION OF ORTHOPHOSPHATE, SULFATE, AND CHLORIDE IN NATURAL WATER SAMPLES WITH HIGH IRON CONCENTRATIONS USING ION CHROMATOGRAPHY,
Geological Survey, Reston, VA.
N. S. Simon.
Analytical Letters ANALBP, Vol. 21, No. 2, p 319-330, 1988. 1 fig, 2 tab, 18 ref.

Descriptors: *Chemical analysis, *Orthophosphates, *Sulfates, *Chlorides, *Sediments, *Chromatography, *Trace levels, River sediments, Interstitial water, Iron.

A rapid procedure developed for the analysis of orthophosphate, sulfate and chloride in riverine sediment interstitial water samples which have dissolved iron concentrations ranging from 0.5-2 mmol/L. Interferences caused by the precipitation of iron hydroxides resulting from air oxidation of ferrous iron in the anoxic samples and from the alkaline working pH range (9.0-10.5) of the Dionex ion chromatographic system were eliminated by complexing the iron with cyanide. Orthophosphate concentration values are compared with dissolved reactive phosphate concentration data for the same samples. Orthophosphate concentrations rather than dissolved reactive phosphate concentrations were preferred for phosphate mineral solubility calculations and for phosphorus nutrient measurements. (Author's abstract)
W88-07434

ENVIRONMENTAL STATUS OF BISMUTH AND ITS TRACE ANALYSIS ON ALLOYS, PLANT TISSUES, ANIMAL TISSUES AND WATERS AS TERNARY COMPLEX WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND A PYRIDYLAZO REAGENT,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 21, No. 3, p 461-476, 1988. 1 fig, 6 tab, 16 ref.

Descriptors: *Bismuth, *Trace metals, *Chemical analysis, Water analysis, Wastewater analysis.

A new series of reagents, N-phenyl-2-furylacrylohydroxamic acid and its eight analogues, together with eight pyridylazo reagents, were explored for the selective extraction and sensitive spectrophotometric determination of bismuth(III) in standard alloys and environmental matrices, including water and wastwater. Bismuth was first extracted with a hydroxamic acid into chloroform and a pyridylazo reagent was added to the extract to form an intensely colored ternary complex. The combination of N-p-methoxyphenyl-2-furylacrylohydroxamic acid and 5-iodo-5-(dimethylamino)-2-(2-pyridylazo)phenol provided the maximum selectivity and sensitivity . The enrichment attained through solvent extraction together with the intense color of the ternary complex enabled analysis of bismuth at levels of 1 ppb (0.001 ppm) and lower. (Author's abstract)
W88-07435

RAPID SYNERGISTIC EXTRACTION AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF IRON IN ENVIRONMENTAL SAMPLES USING TRIBUTYL PHOSPHATE AND N-PHENYL-2-FURYLACRYLOHYDROXAMIC ACID,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 21, No. 3, p 491-505, 1988. 2 fig, 2 tab, 18 ref.

Descriptors: *Iron, *Chemical analysis, *Atomic absorption spectrophotometry, *Wastewater analysis, Water analysis.

Iron(III) was rapidly extracted as its ternary complex with tributyl phosphate and N-phenyl-2-furylacrylohydroxamic acid (PFHA) from weakly acidic (pH 1.0-1.5) solutions into isobutyl methyl ketone and was determined by atomic absorption spectrophotometry. The method tolerated the presence of a large number of anions and cations commonly associated with iron, and was successfully tested with certified samples of coal fly ash, alloys, and plant tissues. It was also applied to the analysis of animal tissues, natural waters, and wastewaters, validating it by standard addition technique. PFHA was selected from 9 new hydroxamic acids. (Author's abstract)
W88-07436

USE OF R2A MEDIUM AND THE SPREAD PLATE METHOD FOR THE ENUMERATION OF HETEROTROPHIC BACTERIA IN DRINKING WATER,
Anglian Water Laboratory, Grafham Water Treatment Works, West Perry, Huntingdon PE18 0BW, UK.
R. A. Gibbs, and C. R. Hayes.
Letters in Applied Microbiology, Vol. 6, No. 2, p 19-21, February 1988. 2 tab, 12 ref.

Descriptors: *Drinking water, *Potable water, *Heterotrophic bacteria, *Bacterial analysis, Bacteria, Testing procedures, Incubation, Microbiological studies.

The pour plate method with yeast extract agar and a 3 day incubation period is the standard method in the U.K. for the enumeration of heterotrophic bacteria in drinking water. The standard method was compared with other procedures using the spread plate technique, R2A medium and a longer incubation period. The R2A spread plate method with a 7 d incubation period gave an average estimate of bacterial numbers 520 times greater than the standard method. This alternative method is recommended for obtaining a more accurate estimate of heterotrophic bacterial populations in drinking water. (Author's abstract)
W88-07488

FATHEAD MINNOW FHM CELLS FOR USE IN IN VITRO CYTOTOXICITY ASSAYS OF AQUATIC POLLUTANTS,
Rockefeller Univ., New York. Lab. Animal Research Center.
H. Babich, and E. Borenfreund.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 78-87, August 1987. 6 fig, 2 tab, 31 ref.

Descriptors: *Toxicity, *Bioassay, *Water pollution effects, *Cytotoxicity, Organic compounds, Minnows, Polychlorinated biphenals.

The suitability of the fathead minnow (FHM) epithelial cell line for use as the target (indicator) system in in vitro cytotoxicity assays was evaluated using several endpoints. The organometal diethyltin dichloride served as the representative test agent. The concentration of diethyltin dichloride that resulted in a midpoint toxicity was 3.5 microM in a 3-day cell growth assay, 3.8 microM in the 24-hr neutral red assay, and 16.5 microM in a 4-hr cell detachment assay. The neutral red assay was used to compare the relative sensitivities of the FHM cells (exposed at 35C) with those of bluegill sunfish (BF-2) cells, a fibroblastic cell culture (exposed at 26C), in the presence of different classes of test agents frequently occurring as aquatic pollutants. For both fish species the sequence of potencies of the test agents was in the order of organometals > pesticides = polychlorinated biphenyls > polynuclear aromatic hydrocarbons > phenolics. Overall, the FHM cells were more sensitive than were the BF-2 cells. However, there was a better correlation between the in vitro cytotoxicity data for the BF-2 cell culture and LC sub 50 data for bluegill sunfish than between similar data for the FHM cell line and fathead minnows. (Author's abstract)
W88-07500

COMMUNITY DEGRADATION INDEX: A NEW METHOD FOR ASSESSING THE DETERIORATION OF AQUATIC HABITATS,
Estuaries and Coastal Processes Division, The National Institute for Water Research, P.O. Box 17001, Congella 4036, Republic of South Africa.
For primary bibliographic entry see Field 5C.
W88-07540

DETECTION OF HUMAN ROTAVIRUS IN SEWAGE THROUGH TWO CONCENTRATION PROCEDURES,
Barcelona Univ. (Spain). Dept. of Microbiology.
A. Bosch, R. M. Pinto, A. R. Blanch, and J. T. Jofre.
Water Research WATRAG, Vol. 22, No. 3, p 343-348, March 1988. 5 tab, 30 ref.

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Viruses, Rotaviruses, Microbiological studies.

Two different methodologies for the detection of human rotavirus in water were compared. Simian rotavirus SA11 was used to develop these procedures in the laboratory with distilled water, tap water, and raw sewage. The adsorption to and elution from glass powder method was used to concentrate seeded rotavirus from 20-liter samples of water and yielded satisfactory recoveries of viruses from distilled and tap water (54 and 46%, respectively) but poor recovery (5%) from raw sewage. In the second concentration methodology, rotaviruses were concentrated from 600-ml samples by ammonium sulfate flocculation after the addition to samples of beef extract up to a 10% final concentration. Rotaviruses were recovered from raw sewage without any substantial loss compared to distilled and tap water (67% in raw sewage, and 70 and 73% in distilled water and tap water). The ammonium sulfate method consistently yielded greater viral recoveries than the adsorption-elution method, although the latter enabled the processing of larger volume samples. Both methodologies were applied to detect human rotavirus in raw sewage at two Barcelona wastewater effluents. Human rotavirus in sewage isolates was quantitated by immunofluorescence in the MA-104 cell line. Indigenous rotavirus was detected in 100% of sewage samples using both concentration procedures; rotaviruses were also found in 69% of nonconcentrated samples. The level of rotaviruses found in Barcelona sewage was very high (up to 14,000 fluorescent foci/liter), being of the same magnitude as the level of enteroviruses, although no correlation was found with the levels of human enteric viruses. (Author's abstract)
W88-07546

SIMPLIFIED METHOD FOR THE DETECTION OF GALLIONELLA IN WATER,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
F. Ahmed, and P. G. Smith.
Water Research WATRAG, Vol. 22, No. 3, p 395-396, March 1988. 1 fig, 2 ref.

Descriptors: *Pollutant identification, *Water analysis, *Iron bacteria, *Bacteria, Gallionella, Microbiological studies.

A smear slide technique was used to identify rapidly Gallionella, which are usually deposited along with ferric precipitates. The method involved no staining, just evaporation of moisture from a slide by passing through a flame followed by examination at 1000x magnification. The bacteria were readily distinguished from the iron deposits. (Cassar-PTT)
W88-07553

SURFACE GEOELECTRICS FOR GROUNDWATER POLLUTION AND PROTECTION STUDIES,
Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia).
For primary bibliographic entry see Field 7B.
W88-07564

SURVEY ON YERSINIA ENTEROCOLITICA AND RELATED BACTERIA IN SHELLFISH,
Yersinia Reference Center, 3rd Dept. of Pediatrics, 'La Sapienza' Univ. of Rome, Inst. of Experimental Medicine CNR, Rome, Italy.
C. Chiesa, A. D. Pra, G. Guarneri, S. Penso, and L. Rodella.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 241-244, July 1987. 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Path of pollutants, *Food chains, *Microbiological studies, *Shellfish, *Yersinia, *Mollusks, *Bacteria, Bioindicators, Microorganisms, Pathogens, Human diseases.

Results from examining shellfish collected from 'safe'(2-34 Escherichia coli/100 mL) and 'unsafe' (> 34 E. coli/100 mL) waters for the presence of Yersinia enterocolitica and related bacteria are reported. The recovery of these microorganisms was low in bivalve mollusks destined for food consumption, high in those derived from prohibited areas. No human pathogenic bio-serogroup of Yersinia was found during the entire survey. (Author's abstract)
W88-07589

STREPTOCOCCAL POPULATION PROFILES AS INDICATORS OF WATER QUALITY,
Dept. of Microbiology, Univ. of Vermont, Burlington, VT 05405 U.S.A.
A. A. Rutkowski, and R. E. Sjogren.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 273-284, July 1987. 7 tab, 45 ref.

Descriptors: *Water quality, *Analytical methods, *Microbiological studies, *Pollutant identification, *Culturing techniques, Water pollution sources, Streptococcus, Bacterial physiology, Bacteria.

The streptococcal flora of two sewage treatment facilities, lake water receiving effluent from a sewage treatment facility, and the feces of five animals were examined. An improved medium, designated M2 allowed the isolation of a total of 3314 streptococcal strains representing 17 species. Thirteen of these species were assembled into groups based upon similarities in ecology or physiology. Comparison of the proportions of these groups with samples from various sources allowed populations from human sources to be distinguished from animal derived populations. The streptococcal populations of three streams were examined and the concept of environmentally significant groups applied to define the types of contamination present. (Author's abstract)
W88-07590

EVALUATION OF TWO BACTERIOPHAGES AS SEWAGE TRACERS,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
L. W. Sinton, and S. B. Ching.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 347-356, October 1987. 3 fig, 1 tab, 34 ref.

Descriptors: *Bacteriophages, *Tracers, *Sewage, *Path of pollutants, *Bioindicators, *Wastewater, *Wastewater analysis, *Escherichia coli, Effluents, Food-processing wastes, Performance evaluation, Field tests, Bioassay, Wastewater.

Two bacteriophages - phage 80 of Staphylococcus aureus and a P2-like phage (phi MWD 1) of Escherichia coli (H2S+) - were evaluated as sewage tracers. Background plaque concentrations on the S. aureus host were < 1100/ml in seven (raw and treated) effluents tested but, on E. coli (H2S+), they ranged from <1100/ml in oxidation pond effluents to 1100/100 ml in primary treated meatworks effluent. Thus, phage 80 appears to be a suitable tracer for both raw and treated sewage but phi MWD 1 may only be suitable for use in secondary treated effluent. In frozen samples, concentrations of both tracer phages were reduced by 90% within 2 days, but decreased more slowly over the following 68 days to around 5% of the original (unfrozen) titre. In a field test, the two phages were used simultaneously to trace the movement of oxidation pond effluents down a river system. Freezing samples for later assay increased sampling program flexibility and eliminated overgrowth interference from sewage bacteria. The lack of simple, reliable, and universally applicable concentration techniques limits the widespread use of bacteriophages as sewage tracers. (Alexander-PTT)
W88-07604

BULK SEDIMENT BIOASSAYS WITH FIVE SPECIES OF FRESH-WATER OLIGOCHAETES,
National Swedish Environmental Protection Board, Environmental Quality Lab., Freshwater Section, Box 8005, S-750 08 Uppsala, Sweden.
For primary bibliographic entry see Field 5C.
W88-07611

EFFECT OF TOXICANTS ON ALGAL SINKING RATES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5C.
W88-07612

ASSESSMENT OF THE BACTERIOLOGICAL QUALITY OF RURAL GROUNDWATER SUPPLIES IN NORTHERN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
J. E. Sworobuk, C. B. Law, and G. K. Bissonnette.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 163-170, November 1987. 6 tab, 15 ref.

Descriptors: *Coliforms, *Groundwater pollution, *Bioassay, *Microbiological studies, Microorganisms, Feces, Water supply systems, Wells, Bacteria, Rural aredas, Streptococcus.

A bacteriological survey was performed on 155 untreated, individual, rural groundwater supplies which included drilled wells, dug wells, and springs. Of these, 105 exceeded the Environment Protection Agency (EPA) maximum contaminant level of one total coliform per 100 mL. Repeat sampling for 87 of the unacceptable 105 supplies indicated that 76 again exceeded the EPA standard limit. Masked coliforms were detected through confirmation tests in 11 water supplies that exhibited excessive noncoliform colonies (> 50 CFU's/membrane filter). Also, 48% of the supplies contained fecal coliforms and 62% contained fecal streptococci. Bacterial densities were related to the type of water supply with drilled wells containing fewer total coliforms, fecal coliforms, fecal streptococci, and heterotrophic plate count bacteria than dug wells or springs. Water supplies that were shallower, older, and lacking adequate casing characteristically were more heavily contaminated with sanitary indicator bacteria than supplies that were deeper, of more recent construction, and with sufficient casing. (Author's abstract)
W88-07613

DESIGN AND USE OF A COLLECTOR FOR THE IN SITU ISOLATION OF PARTICULATE TRACE ORGANIC SPECIES IN PRECIPITATION,
Oregon State Univ., Newport. Hatfield Marine Science Center.
M. A. Mazurek, B. R. T. Simoneit, L. J. Standley, D. Friedman, and C. Beeman.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 171-192, November 1987. 7 fig, 3 tab, 49 ref. NSF Grants ATM 81-16622 and ATM 81-18101.

Descriptors: *Analytical methods, *Measuring instruments, *Simulated rainfall, *Particulate matter, *Organic carbon, *Rainfall, Chromatography, Pollutant identification, Water pollution sources, Air pollution, Extraction.

Extracts of particulate organic matter were examined for discrete rainfall events from metropolitan Los Angeles, California, using an in situ filtration technique. Filtration efficiency was 98% for the collection of extractable organic C associated with particles having nominal diameters >0.22 microns. Organic background levels of <260 ng per sample were determined. Rainwater particle samples were extracted with repeated hexane and benzene:isopropanol (2:1) solvent additions using ultrasonic agitation. Extract mixtures were quantified by high-resolution gas chromatography (HRGC) and were adjusted for component losses with perdeuterated recovery standards. Yields for the neutral fractions ranged from 130 to 669 micrograms with flux rates corresponding to 371 to 1097 micrograms/sq m/day. Aliquots of the neutral solvent extracts were derivatized with diazomethane to convert acidic hydroxy and carboxylic acid groups to the respective methyl ether and methyl ester analogs. This step produced increased yields of 8 to 188%, and resulted in yields for the acid + neutral extracts that ranged from 374 to 868 micrograms with flux rates of 591 to 2343 micrograms/sq m/day. Source identification was conducted by high-resolution gas chromatography/mass spectrometry (HRGC/MS) analyses. Molecular analyses indicated major anthropogenic contributions from petroleum and combustion sources, and for some samples, the significant input of microbial lipid components as well. Minor amounts of vascular plant waxes were also present. These mixed inputs of both anthropogenic and biogenic materials compared closely with previous source determinations for carbonaceous aerosol particles in the Los Angeles air basin. (Author's abstract)
W88-07614

ENHANCED FLUORESCENCE DETECTION OF DANSYL DERIVATIVES OF PHENOLIC COMPOUNDS USING A POSTCOLUMN PHOTOCHEMICAL REACTOR AND APPLICATION TO CHLOROPHENOLS IN RIVER WATER,
Dept. of Analytical Chemistry, Free Univ., De Boelelaan 1083, 1081 HV Amsterdam, The Netherlands.
C. de Ruiter, J. F. Bohle, G. J. de Jong, U. A. T. Brinkman, and R. W. Frei.
Analytical Chemistry ANCHAM, Vol. 60, No. 7, p 666-670, April 1988. 5 fig, 1 tab, 23 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Measuring instruments, *Chlorophenols, *Phenols, *Fluorescence, *Photochemical reactions, Detection limits, Calibrations, Chromatography, Performance evaluation, Organic compounds, River water.

Photochemical decomposition by ultraviolet (UV) irradiation of dansyl derivatives of phenolic compounds in methanol-water mixtures leads to the formation of highly fluorescent dansyl-OCH3. With substituted phenols as model compounds, it is demonstrated that inductive effects, caused by the substituents, play a major role in the gain in fluorescence signal (up to 8000-fold) that is obtained after postcolumn UV irradiation of the dansyl derivative, compared to that of the nonirradiated derivative. The optimal irradiation time for the dansyl derivatives now have a comparable limit of detection of approximately 200 pg (S/N = 3). The calibration curve of dansylated pentachlorophenol, using the postcolumn photochemical reactor under

optimal conditions, is linear over at least 3 orders of magnitude with a correlation coefficient of 0.9999 (n = 9). Application of the system to the liquid chromatographic determination of highly chlorinated phenols in river water is presented. The repeatability of the system for a river water sample, spiked with 1 ppb pentachlorophenol, is 2.4% relative standard deviation (n = 5). (Author's abstract)
W88-07633

DETERMINATION OF TRACE METALS IN MARINE BIOLOGICAL REFERENCE MATERIALS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY,
Analytical Chemistry Section, Chemistry Div., National Research Council of Canada, Ottawa, Ontario, Canada K1A 0R9.
D. Beauchemin, J. W. McLaren, S. N. Willie, and S. S. Berman.
Analytical Chemistry ANCHAM, Vol. 60, No. 7, p 687-691, April 1988. 2 fig, 7 tab, 20 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Measuring instruments, *Tissue analysis, *Heavy metals, *Spectrometry, Isotope studies, Detection limits, Performance evaluation, Sodium, Magnesium, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Arsenic, Cadmium, Mercury, Lead, Chromium, Dogfish.

Inductively coupled plasma mass spectrometry (ICP-MS) was used for the analysis of two marine biological reference materials (dogfish liver tissue (DOLT-1) and dogfish muscle tissue (DORM-1)). The materials were put into solution by digestion in a nitric acid/hydrogen peroxide mixture. Thirteen elements (Na, Mg, Cr, Fe, Mn, Co, Ni, Cu, Zn, As, Cd, Hg, and Pb) were then determined. Accurate results were obtained by standard additions or isotope dilution techniques for all of these elements in DORM-1 and for all but Cr in DOLT-1. (Author's abstract)
W88-07634

DETERMINATION OF TRIBUTYLTIN IN TISSUES AND SEDIMENTS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Moss Landing Marine Labs., California Dept. of Fish and Game, Moss Landing, California 95039.
M. D. Stephenson, and D. R. Smith.
Analytical Chemistry ANCHAM, Vol. 60, No. 7, p 696-698, April 1988. 3 tab, 14 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Measuring instruments, *Tissue analysis, *Spectrometry, *Tributyltin, *Sediments, Extraction, Organic compounds, Performance evaluation, Detection limits, Tin.

A method for the determination of tributyltin (TBT) in tissue and sediments has been developed for environmental samples. The technique involves extraction with methylene chloride and isolation of TBT from mono- and dibutyltin with a sodium hydroxide wash. The TBT is then back extracted and converted to elemental Sn with nitric acid. Analysis is by Zeeman graphite furnace atomic absorption spectrophotometry. Recoveries of spiked samples were between 99% for various sediments. The limit of quantification was 0.0025 micrograms/g for tissue (on a wet weight basis). This technique was developed in response to the need to process large numbers of environmental samples with a minimum time investment. (Author's abstract)
W88-07635

BIOMONITORING OF LOW LEVELS OF MERCURIAL DERIVATIVES IN WATER AND SOIL BY ALLIUM MICRONUCLEUS ASSAY,
Berhampur Univ. (India). Dept. of Botany.
S. Dash, K. K. Panda, and B. B. Panda.
Mutation Research MUREAV, Vol. 203, No. 1, p 11-21, February 1988. 5 fig, 4 tab, 37 ref. DOE India Project No. 19/3/87-RE.

Descriptors: *Analytical methods, *Pollutant identification, *Bioassay, *Allium, *Mercury, *Micronucleus test, Fungicides, Disinfectants, Aquatic plants, Heavy metals, Bioaccumulation, Bioindicators, Water pollution effects, Detection limits, Mercuric chlorides, Mercuric acetates, Emisan-6, Plants, Roots, Mitosis.

The Allium micronucleus (MNC) assay was developed to monitor low levels of mercury in aquatic and terrestrial environments. Four mercurial derivatives namely mercuric chloride (MC), methyl mercuric chloride (MMC), phenyl mercuric acetate (PMA) and a methoxy ethyl mercuric chloride based fungicide, Emisan-6, were tested to assess the sensitivity and versatility of the Allium MNC assay. Allium bulbs were set directly on water and soil contaminated with known levels of mercurial derivatives (0.0001-10.00 ppm). On the 5th day the endpoints measured were root length, mitoses with spindle abnormality and cells with MNC in root meristems. The effective concentrations of the test chemicals that cause 50% of root length as compared to control (EC50) were determined from dose-response curves so obtained. The lowest effective concentration tested (LECT) and highest ineffective concentration tested (HICT) for each of the mercurial derivatives for the induction of spindle malfunction and MNC were determined. It was found that EC50, LECT and HICT values for mercurial derivatives in soil were higher than those in water. The frequencies of cells with MNC and mitoses with spindle abnormality were highly correlated indicating that MNC is a good parameter of spindle malfunction. The present approach increased the sensitivity of the Allium assay by 10-fold, the detection limit being 0.001-0.1 ppm and 0.1-1.0 ppm in aquatic and terrestrial environments respectively, depending on the species of mercury. (Author's abstract)
W88-07637

LEGIONELLA PNEUMOPHILA: COMPARISON OF ISOLATION FROM WATER SPECIMENS BY CENTRIFUGATION AND FILTRATION,
Public Health Laboratory, Level 6/7, John Radcliffe Hospital, Headington, Oxford OX3 9DU, England.
R. J. Brindle, P. J. Stannett, and R. N. Cunliffe.
Epidemiology and Infection, Vol. 99, No. 2, p 241-247, October, 1987. 2 fig, 4 tab, 6 ref.

Descriptors: *Legionella, *Isolation, *Water analysis, *Bacterial analysis, *Centrifugation, *Filtration, Filters, Membrane filters, Bacteria, Aquatic bacteria, Pathogenic bacteria, Culture media, Agars, Density, Population density.

Membrane filtration and centrifugation were compared for the isolation of Legionella pneumophila from seeded water samples. Using samples of varying concentration, the optimum speed and time of centrifugation were determined and the relationship between the number of organisms present in the water and the proportion recovered was examined. Following this, sequential routine environmental waters were filtered and centrifuged in parallel. Centrifugation and filtration using nitrocellulose filters were found to be comparable. The optimum speed and time of centrifugation was approximately 6000 g for 10 min. There was a constant proportion of viable organisms recovered irrespective of the concentration in the unspun samples. It is concluded that centrifugation has the advantage of saving time and effort, and that use of different filter materials might reduce the loss that occurs from electrostatic attraction of organisms to the filter surface. (Doria-PTT)
W88-07665

NEW SEROVAR MOGDENI OF SEROGROUP TARASSOVI OF LEPTOSPIRA INTERROGANS ISOLATED FROM A SEWAGE PLANT IN ENGLAND,
Leptospira Reference Laboratory, Public Health Laboratory Service, Colindale, London, England.
J. D. Coghlan, and E. Kmety.
Epidemiology and Infection, Vol. 99, No. 2, p 373-377, October, 1987. 3 tab, 10 ref.

Descriptors: *Leptospira, *Wastewater facilities, *England, *Isolation, *Public health, *Sewage bacteria, Bacterial analysis, Wastewater analysis,r analysis, Microbiological studies, Bacteria, Pathogenic bacteria,ge, Animal diseases, Epidemiology.

Among 30 strains of leptospires isolated from samples of sewage taken in 1977 before and during treatment at two sewage plants in England, only one appeared to belong to Leptospira interrogans, the species that comprises the leptospires that are pathogenic to man and animals. That strain, Compton 746, was isolated from settled sewage, before treatment at a treatment plant that deals mainly with human sewage. The strain was shown serologically to belong to serogroup Tarassovi and appears to represent a new serovar that has been named mogdeni after the name of the sewage plant Mogden, from which it was isolated. It is not known how the strain came to be in sewage nor what was the animal source. (Author's abstract)
W88-07666

BACTERIOLOGICAL QUALITY OF TRADITIONAL WATER SOURCES IN NORTH-EASTERN IMO STATE, NIGERIA,
London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
D. Blum, S. R. A. Huttly, J. I. Okoro, C. Akujobi, and B. R. Kirkwood.
Epidemiology and Infection, Vol. 99, No. 2, p 429-437, October, 1987. 4 fig, 1 tab, 13 ref.

Descriptors: *Water quality, *Bacterial analysis, *Water analysis, *Drinking water, *Nigeria, *Public health, Ponds, Rivers, Springs, Wells, Bacteria, Coliforms, Streptococcus, Water pollution, Filters, Membrane filters, Filtration, Epidemiology.

Monthly bacteriological water testing of traditional water sources (ponds, rivers, unprotected springs, traditional wells) used by five villages in north-eastern Imo State, Nigeria was conducted during the period January, 1983 to August, 1985. The membrane-filtration technique was used to detect fecal coliforms (FC) and fecal streptococci (FS). Evidence of fecal pollution was seen throughout the year for all water sources. During the study period, the monthly geometric mean counts per 100 ml of water (all sources combined) ranged from 760 to 17,877 for FC and from 678 to 17,394 for FS. The peak period of fecal pollution occurred during the transition between the dry and wet seasons and in the early wet season. During this peak pollution season (February-May), the geometric mean counts were 2.5-7.2 times higher than in the remaining part of the year for all source types except rivers, with ponds being the most heavily polluted. Preliminary findings are presented on the sensitivity and specificity of the standard membrane-filtration technique for enumerating FC in this tropical environment. The implications for the environmental control of waterborne and hygiene-related diseases are discussed. (Author's abstract)
W88-07667

BACTERIOLOGICAL QUALITY OF BOTTLED NATURAL MINERAL WATERS,
Public Health Laboratory, University Hospital of Wales, Heath Park, Cardiff CF4 4XW, Wales.
P. R. Hunter, and S. H. Burge.
Epidemiology and Infection, Vol. 99, No. 2, p 439-443, October, 1987. 1 tab, 14 ref.

Descriptors: *Bacterial analysis, *Water analysis, *Mineral water, *Public health, *Drinking water, *Water quality, Microbiological studies, Bacteria, Pathogenic bacteria, Coliforms, Aeromonas, Contamination, Staphylococcus, Public health.

Fifty-eight bottles of natural mineral water taken from the point of sale were examined bacteriologically. Of these, 29 were carbonated and 29 still. No coliforms or Aeromonas spp. were isolated from any sample. High bacterial counts were found, particularly in the still waters. There was no significant difference between total viable counts from domestic and imported waters. Most of the organisms isolated in the total counts were Gram-negative rods, although Gram-positive organisms

were also isolated. There were no differences in the provisional identification of organisms isolated from carbonated and still waters or from those waters yielding high or low counts. Gram-positive cocci were further identified, some of which were known human commensals, suggesting contamination of the waters prior to bottling. It is concluded that bottled natural mineral waters are not as microbiologically pure as some suppliers may claim, and that these waters should not be used as drinking water for infants. (Doria-PTT)
W88-07668

DETERMINATION OF PHENOL IN WATER BY FLOW INJECTION ANALYSIS,
Tecator AB, Box 70, S-263 01 Hoganas, Sweden.
J. Moller, and M. Martin.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 329, No. 6, p 728-731, January, 1988. 6 fig, 6 tab, 9 ref.

Descriptors: *Phenols, *Chemical analysis, *Water analysis, *Flow injection analysis, *Automation, Industrial wastes, Condensation, Sample preparation, Chloroform, Dyes, Detection limits, Distillation, Reagents, Photometry, Spectrophotometry.

An automated procedure for determining phenol was described by adapting the 4-aminoantipyrine method to flow injection analysis (FIA). Two manifolds were developed, one for the direct determination of phenol in the aqueous phase, and one using chloroform extraction in a new extraction manifold. A maximum sensitivity enhancement of 3.5 was obtained compared to the direct FIA manifold. The detection limit was 0.005 ppm phenol. A forced steam distillation method is also described, allowing the distillation of phenols within 2-5 minutes. (Doria-PTT)
W88-07679

FUNDAMENTAL STUDIES ON THE COPRECIPITATION OF NANOGRAM QUANTITIES OF SOME METALS WITH THE DIMETHYLGLYOXIME/NI/1-(2-PYRIDYLAZO)-2-NAPHTHOL COMPLEX AND THEIR DIRECT DETERMINATION BY ATOMIC ABSORPTION SPECTROMETRY USING AN INNER MINIATURE CUP FOR THE SOLID SAMPLING TECHNIQUE: APPLICATION TO NATURAL WATERS,
Kitami Inst. of Tech., Hokkaido (Japan).
I. Atsuya, and K. Itoh.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 329, No. 7, p 750-755, January, 1988. 5 fig, 6 tab, 21 ref. Ministry of Education (Japan) Grant-in-Aid No. B-61470033.

Descriptors: *Precipitation, *Trace metals, *Chelating agents, *Atomic absorption, *Atomic spectrophotometry, *Water analysis, *Chemical analysis, Photometry, Sampling, Heavy metals, Cadmium, Copper, Manganese, Lead, Zinc, Lakes, Seawater, Standard deviation, Reagents, Detection limits.

A new easy, sensitive, and accurate AAS method using an inner miniature cup in conjunction with a cupped type electrothermal graphite furnace for the solid sampling technique was proposed for the determination of sub-ppb levels of Cd, Cu, Mn, Pb, and Zn in lake or sea water. It implies direct measurement of the coprecipitate obtained by using a combination of dimethylglyoxime (DMG) and nickel ion as carrier element and 1-(2- pyridylazo)-2-naphthol (PAN) as an auxiliary complexing agent. Fundamental studies on the coprecipitation with the DMG/Ni/PAN complex have been carried out to determine sub-ppb levels of elements in water samples. The analytical sensitivity compared with a conventional method using GF-AAS was increased at least 1,000-fold, because the measurement of the coprecipitates was without redissolution. The standard deviations for 0.1- 0.5 ppb Mn in water samples were found to be 1-5%. (Author's abstract)
W88-07680

ISOLATION OF CHLORINATED HYDROCARBONS FROM PETROLEUM HYDROCARBONS FOR MASS SPECTROMETRIC IDENTIFICATION,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
V. de Simone, E. Fogelqvist, R. Schneider, and J. Pasanau.
Toxicological and Environmental Chemistry TXECBP, Vol. 16, No. 1, p 51-60, 1987. 3 fig, 3 tab, 7 ref.

Descriptors: *Chlorinated hydrocarbons, *Pollutant identification, *Hydrocarbons, *Separation techniques, *Mass spectrometry, *Chromatography, Organochlorine compounds, Aliphatic hydrocarbons, Insecticides.

Electron impact ionization mass spectrometric (MS) confirmation of organochlorine insecticides and polychlorinated biphenyls (PCBs) in extracts from environmental samples cleaned up for electron capture detection gas chromatography (GC) analysis is often hampered by the presence of petroleum hydrocarbons, usually appearing in concentrations highly above, and interfering with, those of organochlorine compounds. A clean-up procedure is presented, by which the organochlorinated compounds are isolated from aliphatic as well as polyaromatic (petroleum) hydrocarbons through a gel permeation high performance liquid chromatography (HPLC) and adsorption chromatography on silica microcolumns. Gel permeation HPLC separation gives three fractions containing, in order of elution: (1) aliphatic hydrocarbons, (2) chlorinated hydrocarbons except hexachlorobenzene, and (3) aromatic hydrocarbons with hexachlorbenzene. Subsequent silica microcolumn chromatography of the third fraction, separates hexachlorobenzene from the aromatic hydrocarbons. Combination of the fraction containing the chlorinated hydrocarbons from the HPLC separation (the second fraction eluted) with the fraction containing hexachlorobenzene from the microcolumn separation gives a mixture of organochlorine compounds which can be confirmed by GC-MS without interference from petroleum hydrocarbons. (Wood-PTT)
W88-07696

RAPID STATISTICAL CORRELATION BETWEEN POLLUTION SOURCES AND MARINE CONCENTRATIONS,
Institute of Oceanography, Bulgarian Academy of Sciences, 9000 Varna, Bulgaria.
G. Andreev, and V. Simeonov.
Toxicological and Environmental Chemistry TXECBP, Vol. 16, No. 1, p 69-73, 1987. 2 fig, 16 ref.

Descriptors: *Path of pollutants, *Marine environment, *Water pollution sources, *Correlation analysis, Distribution graphs, Statistical methods, Pollutants, Fluoride, Hydrogen ion concentration, Ammonia, Phosphates, Heavy metals.

An easy approach for rapid estimation of the connection between concentration of inorganic pollutants in the marine environment and the distance from the possible source of pollution is suggested. The sampling, required analytical work and concentrations of ten components characterizing inorganic pollution of the marine environment were reported previously. The components determined were: fluoride, pH, ammonia (by potentiometry with ion-selective electrodes), phosphate, iron (with and without sample filtration), copper (spectrophotometrically determined with and without sample filtration), lead, cadmium, zinc, and mercury. The correlation coefficient for each couple of pollutants was determined and distribution graphs of the calculated correlation coefficients were constructed. The graphs can be used to estimate the connection between pollution factors (concentration of pollutants) and possible anthropogenic activities (distance from the coast) and to determine the region of influence of a given polluting source or group of sources. It is suggested that the approach be applied to bigger data sets from different marine systems and for different pollutants in order to check its indicator ability. (Wood-PTT)
W88-07697

CLEANUP OF BIOLOGICAL EXTRACTS BY A PASTEUR PIPETTE COLUMN AND A COMPARISON OF IN VIVO-ACCUMULATED CHLORINATED PESTICIDE RESIDUES WITH OTHER CLEANUP SYSTEMS,
Chemistry Branch, Biological and Chemical Research Institute, PMB 10, Rydalmere, NSW, 2116, Australia.
N. Ahmad, R. S. Marolt, and G. Singh.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 23, No. 1, p 69-83, February 1988. 5 tab, 6 ref.

Descriptors: *Chromatography, *Pollutant identification, *Separation techniques, *Pasteur pipettes columns, *Pesticides, Monitoring, Comparison studies, Pollutants, Detection limits, DDT, Metabolites.

Biological samples were extracted with a new solvent system consisting of n-hexane/acetone (60:40) and 1 mL of the concentrated extract was eluted through a pasteur pipette column prepacked with alumina (0.3 g) and silicic acid (0.25 g) with 10 mL n-hexane (containing 4% acetone). The fat and other co-extractives are retained by the column and clear eluate is directly injected on a GLC column for determination on electron capture detector. A comparison of the pasteur pipette cleanup with the modified method of Cole et al. on 41 samples of fish, the One Step Method on 86 samples of fish, and the method of Maunder at al. on 10 types of wildlife (100 samples) was made. The pasteur pipette method gives results which are significantly higher ($p>0.5$) than the other methods except the One Step Method. The new method is quick, inexpensive, accurate and suitable for monitoring residues in the environment and analyzing single carcasses in the abattoirs. Its detection limit is 0.01 micrograms/gram for DDT and its metabolites. (Wood-PTT)
W88-07713

SUMMARY OF DATA FROM A TOXICS SCREENING SURVEY OF THE LOWER SUSQUEHANNA RIVER AND MAJOR TRIBUTARIES,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07718

WATER QUALITY AND BIOLOGICAL SURVEY OF THE CHEMUNG RIVER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07722

NUTRIENT MONITORING OF THE LOWER SUSQUEHANNA RIVER AND SELECTED TRIBUTARIES, OCTOBER 1, 1984 - SEPTEMBER 30, 1986: INTERIM REPORT,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 7A.
W88-07737

COMPARISON OF DISSOLVED AND LEACHABLE TRACE METALS IN LOS ALAMOS DRINKING WATER SUPPLY AND DISTRIBUTION SYSTEM SPECIMENS,
Los Alamos National Lab., NM.
R. D. Robinson, and D. Knab.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-012082. Price codes: A02 in paper copy, A01 in microfiche. Report No. LA--11042-MS, July 1987. 12 p, 6 tab, 2 ref, append.

Descriptors: *Water distribution, *Trace metals, *Los Alamos, *Drinking water, *Pollutant identification, *Water quality, Arsenic, Barium, Chromium, Cadmium, Heavy metals, Comparison studies, Lead.

Leachable and dissolved priority pollutant trace-metal concentrations were determined in a subset of specimens from the Los Alamos Drinking Water Supply and Distribution System. Leachable lead concentrations obtained, although below the Environmental Protection Agency's Maximum Contaminant Level, averaged 10 micrograms/L compared with the < 1 microgram/L for the dissolved species. Differences were also observed between leachable and dissolved concentrations for arsenic, barium, chromium and cadmium, but these may be due to a lack of analytical precision. The observed differences in concentrations between leachable and dissolved metals support an expanded analytical program to include all the specimens collected from the Los Alamos Drinking Water Supply and Distribution System. The expanded program should also include analysis for the secondary pollutant metals copper, iron, manganese, and zinc and a comparison of leachable, total suspended solids and total metals to determine if the differences in concentrations are due to inadequate sample preservation or the presence of non-dissolved species. (Author's abstract)
W88-07747

ORGANIC SOLUTE PROFILE OF WATER FROM RIO BLANCO RETORT 1,
Western Research Inst., Laramie, WY.
For primary bibliographic entry see Field 5B.
W88-07773

CARCINOGENIC EFFECTS OF ARSENIC COMPOUNDS IN DRINKING WATER,
University of the Pacific, Stockton, CA. School of Pharmacy.
For primary bibliographic entry see Field 5C.
W88-07779

ORGANIC POLLUTANTS IN WATER: SAMPLING, ANALYSIS, AND TOXICITY TESTING.
Advances in Chemistry series, No. 214. Developed from a Symposium Sponsored by the Divisions of Environmental and Analytical Chemistry at the 188th Meeting of the American Chemical Society, Philadelphia, Pennsylvania, August 29-31, 1984. American Chemical Society, Washington, DC. 1987. 797 p. Edited by I. H. Suffet and M. Malaiyandi.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Water pollution, Chemical analysis, Resins, Drinking water, Toxicity, Reverse osmosis, Membrane processes.

This book deals with developing analytical protocols for concentrating organics for toxicity testing; isolating nonpolar and polar organics from water; and using reverse osmosis, synthetic polymers, and other methods for composite samples. All of the analytical methods discussed are based on phase-transfer processes in which the compound is isolated by a second phase (e.g., solvent or resin) or separated by a membrane phase. Regulatory aspects of using biological testing are also presented. Although the U.S. EPA is proposing maximum contaminant levels for specific chemicals in drinking water, the agency is still interested in seeing if a surrogate toxicity measure can be used to replace specific chemical analysis for chemicals of health concern. Also, the Denver Water Board is currently developing a reuse water treatment system and is planning to isolate organics from the drinking water for the purpose of biological testing. Denver projects that it will use 10% direct drinking water reuse of reclaimed wastewater if the reuse water can be proved to be as healthy as its present water supply. A panel discussion at the end of the book describes the potential biolobical hazards of drinking water and the needs and applications of the analytical methods presented in the book. (See W88-07784 thru W88-07819) (Lantz-PTT)
W88-07783

CONCENTRATION TECHNIQUES FOR ISOLATING ORGANIC CONSTITUENTS IN ENVIRONMENTAL WATER SAMPLES,
Oak Ridge National Lab., TN.
R. L. Jolley, and I. H. Suffet.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 3-14, 2 tab, 58 ref. DOE Contract No. DE-AC05-840R21400.

Descriptors: *Chemical analysis, *Organic compounds, *Pollutant identification, *Water analysis, *Water sampling, *Concentration techniques, Lyophilization, Vacuum distillation, Membrane processes, Solvents, Resins.

Solutions must be concentrated or the constituents must be isolated before trace amounts of various organics present as complex mixtures in environmental water samples can be chemically analyzed or tested for toxicity. A major objective is to concentrate or isolate the constituents with a minimum of chemical alterations to optimize the generation of useful information. Factors to be considered in selecting a concentration technique include the nature of the constituents (e.g., volatile, nonvolatile), volume of the sample, and analytical or test system to be used. The principal methods currently in use involve (1) concentration processes to remove water from the samples (e.g., lyophilization, vacuum distillation, and passage through a membrane) and (2) isolation processes to separate the chemicals from the water (e.g., solvent extraction and resin adsorption). Lyophilization is recommended for sample volumes <100 L when concentrates with high concentration factors are necessary. Ultrafiltration may also be used. For sample volumes >100 L when medium range concentration factors are required, successive ultrafiltration and dialysis, or reverse osmosis, are feasible. (Lantz-PTT)
W88-07784

INTERIM PROCEDURES FOR PREPARING ENVIRONMENTAL SAMPLES FOR MUTAGENICITY (AMES) TESTING,
S-CUBED, Division of Maxwell Labs., San Diego, CA.
P. J. Marsden, D. F. Gurka, L. R. Williams, J. S. Heaton, and J. P. Hellerstein.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 15-38, 6 fig, 27 ref.

Descriptors: *Sample preparation, *Mutagenicity, *Pollutant identification, *Water pollution effects, *Ames test, Organic compounds, Environmental effects, Chemical analysis, Dimethyl sulfoxide, Water sampling, Wastewater composition.

Protocols for preparing six environmental sample types prior to the Ames Salmonella assay were proposed at a recent panel discussion sponsored by the U.S. EPA and the U.S. Army. Air particles, soil-sediment, and solid waste are extracted with dichloromethane, concentrated, and solvent exchanged into dimethyl sulfoxide (DMSO). Organics in water and wastewater are absorbed onto XAD columns, then eluted with hexane-acetone, solvent reduced, and exchanged into DMSO. Nonaqueous liquids are assayed directly and as concentrates before they are solvent exchanged to DMSO. If bacterial toxicity or lack of dose response is observed in the Ames assay of extracts, the extracts are fractionated prior to solvent exchange. These are interim methods and have not been subjected to policy review of the U.S. EPA or the U.S. Army. (See also W88-07783) (Author's abstract)
W88-07785

CONCENTRATION TECHNIQUES AIMED AT THE ASSIGNMENT OF ORGANIC PRIORITY POLLUTANTS,
National Inst. of Public Health and Environmental Hygiene, P.O. Box 150, 2260 AD Leidschendam, The Netherlands.
G. J. Piet, J. A. Luijten, and R. C. C. Wegman.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 39-61, 10 fig, 5 tab, 36 ref.

Descriptors: *Pollutant identification, *Water pollution effects, *Organic compounds, *Water analysis, *Priorities, Chemical analysis, Concentration techniques, Case studies, Toxicity, Fish, Dioxins, Polychlorinated compounds, Bioconcentration, Adsorption, Membrane processes, Ion exchange.

Environmental research should preferably be effect-oriented to assign and define priority pollutants and compound-directed to control pollution within existing and protected legislation. In an integral concept, concentration techniques and instrumental measurement of organic priority pollutants must be appropriate and available for various environmental compartments. Multi-component concentrates derived from environmental samples have been submitted to biological test systems to measure the effect parameters followed by analytical-chemical characterization. Methodologies (bioconcentration, adsorption-desorption, cryogenic trapping, electric fields, membrane filtration, ion exchange, centrifugation, liquid extraction, gas stripping, freeze techniques and distillation) and criteria (representative for effects, representative for compounds, sufficient material for statistic reliability, sufficient material for time series (trends), compatible with test system, background and artifacts known, problem oriented, maximum selectivity) in assigning priority pollutants, the interface and transit function of concentration techniques, and the criteria for concentration techniques in these functions as described. As illustrative applications, toxicity and mutagenicity of surface water, mutagenicity of fish bile extract, and isolation and instrumental measurement of polychlorinated dibenzofurans and polychlorinated dioxins are presented. (See also W88-07783) (Lantz-PTT)
W88-07786

ANALYTICAL METHODS FOR THE DETERMINATION OF VOLATILE NONPOLAR ORGANIC CHEMICALS IN WATER AND WATER-RELATED ENVIRONMENTS,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
J. J. Lichtenberg, J. E. Longbottom, and T. A. Bellar.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 63-81, 1 fig, 2 tab, 33 ref.

Descriptors: *Pollutant identification, *Volatile organics, *Organic compounds, *Water analysis, Monitoring, Water quality control, Gas chromatography, Mass spectrometry, High performance liquid chromatography.

State-of-the-art methods for the analysis of volatile nonpolar organic chemicals that require monitoring as a result of the Safe Drinking Water and Clean Water Acts are reviewed. Methods for the determination of purgeable volatile and semivolatile organic priority pollutants and other organic chemicals identified as hazardous or toxic are discussed. Recommended procedures for sample collection, preparation, identification, and quantification are presented. The emphasis is on compound-specific methods such as gas chromatography employing packed and capillary columns with conventional and mass spectrometric detectors. High-performance liquid chromatographic methods are also included. Accuracy, precision, and detection limit data are presented or discussed for many of the analytes. Quality control practices recommended for proper application of the methods are given. Mandatory quality control practices related to proposed rule making under the Clean Water Act are reviewed. (See also W88-07783) (Author's abstract)
W88-07787

APPLICATION OF THE MASTER ANALYTICAL SCHEME TO POLAR ORGANIC COMPOUNDS IN DRINKING WATER,
Environmental Research Lab., Athens, GA.
A. W. Garrison, and E. D. Pellizzari.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society,

Washington, DC. 1987. p 83-95, 1 fig, 2 tab, 5 ref.

Descriptors: *Qualitative analysis, *Quantitative analysis, *Master Analytical Scheme, *Organic compounds, *Water analysis, *Drinking water, *Pollutant identification, Chemical analysis.

The U.S. EPA Master Analytical Scheme (MAS) for Organic Compounds in Water provides for comprehensive qualitative-quantitative analysis of gas chromatographic organic compounds in many types of water. The analysis of polar and ionic organic compounds - the more water soluble compounds in the MAS repertoire - in raw and treated drinking water is emphasized. Mean recoveries from drinking water made by using the MAS protocols that handle polar and ionic compounds were as follows: 84% for neutral water soluble organic compounds (25 compounds spiked at 1 microgram/L), 89% for extractable semivolatile strong acids (24 compounds spiked at 50-100 micrograms/L), 82% for volatile strong acids (18 compounds spiked at 0.3 micrograms/L), and 81% for strong primary and secondary amines (11 compounds spiked at 35 micrograms/L). The protocol for nonvolatile acids has not yet been applied to spiked drinking water, but recoveries should be higher than the average of 85% (14 compounds spiked at 50 micrograms/L) obtained for these acids in industrial-municipal effluents. (See also W88-07783) (Author's abstract)
W88-07788

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR DETERMINATION OF TRACE ORGANIC COMPOUNDS IN AQUEOUS ENVIRONMENTAL SAMPLES: ASSESSMENT OF CURRENT AND FUTURE CAPABILITIES,
Monsanto Agricultural Co., St. Louis, MO. Life Sciences Research Center.
J. A. Graham.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 97-135, 16 fig, 8 tab, 60 ref.

Descriptors: *Pollutant identification, *Liquid chromatography, *Trace levels, *Quantitative analysis, *Qualitative analysis, *Water analysis, *Organic compounds, *High performance liquid chromatography, Chemical analysis, Spectrophotometry, Gas chromatography, Water sampling.

A review of high-performance liquid chromatographic (HPLC) instrumentation, techniques, and methodologies for the determination of trace organic compounds in water is presented. The review includes approaches to sample cleanup or analyze isolation for those compounds likely to be candidates for analysis by HPLC. Column technology, as it contributes to the use of HPLC for trace organic analyses, is discussed. Finally, various techniques for quantitative and qualitative detection of analytes are discussed, such as: UV-absorption spectrophotometry, fluorescence detection, precolumn derivatization, post column photochemical reactions, and gas chromatography-mass spectrometry. (See also W88-07783) (Lantz-PTT)
W88-07789

FUNDAMENTAL APPROACH TO REVERSE-OSMOSIS CONCENTRATION AND FRACTIONATION OF ORGANIC CHEMICALS IN AQUEOUS SOLUTIONS FOR ENVIRONMENTAL ANALYSIS,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
T. D. Nguyen, T. Matsuura, and S. Sourirajan.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 139-162, 7 fig, 5 tab, 17 ref.

Descriptors: *Pollutant identification, *Reverse osmosis, *Organic compounds, *Water sampling, *Water analysis, Chemical analysis, Pore size, Membrane processes, Aromatic compounds.

The preferential sorption-capillary flow mechanism and its quantitative expression given by the surface force-pore flow model together offer a fundamental approach to the reverse-osmosis concentration of organic chemicals in aqueous solutions for environmental analysis. On the basis of this approach, the attractive and repulsive forces prevailing at the membrane material-aqueous solution interfaces, together with the average pore size and pore size distribution, on the membrane surface, govern reverse-osmosis separations. Data on interfacial interaction force parameters and also data on average pore size and pore size distribution on the membrane surface have been experimentally determined with particular reference to a selected number of organic solutes, a cellulose acetate membrane, and an aromatic polyamidohydrazide membrane. The use of such data for the calculation of parameters relevant to the concentration process is illustrated. (See also W88-07783) (Author's abstract)
W88-07790

CONCENTRATION OF SELECTED ORGANIC POLLUTANTS: COMPARISON OF ADSORPTION AND REVERSE-OSMOSIS TECHNIQUES,
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Directorate.
M. Malaiyandi, R. H. Wightman, and C. LaFerriere.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 163-179, 2 fig, 7 tab, 29 ref. Health and Welfare Canada Contract No. 887-1982/83.

Descriptors: *Pollutant identification, *Organic compounds, *Reverse osmosis, *Water analysis, *Adsorption, Dichlorophenol, Trichlorophenol, Chloraniline, Dichlorobenzidine, Hexachlorocyclohexane, Membrane processes, Polyurethane.

Polar organic pollutants such as 2,4-dichlorophenol, 2,4,5-trichlorophenol, 4-chloroaniline, and 3,3'-dichlorobenzidine and nonpolar organics such as alpha-hexachlorocyclohexane and bis(2-ethylhexyl) phthalate in aqueous solutions were concentrated by an adsorption-desorption technique using XAD-2 and XAD-4 resins and carbon-impregnated polyurethane foam. By using concentrations ranging from parts-per-million to parts-per-trillion levels, both resins behaved similarly in their concentration efficiency; however, the modified polyurethane foam was inadequate for 4-choroaniline. Also compared was the reverse-osmosis technique as a potential method for concentrating the same organic pollutants from aqueous solutions. This study reemphasizes the general ineffectiveness of cellulose acetate membranes for rejecting small organic molecules in low concentrations, whereas polyamide hydrazine and polybenzimidazolone membranes seem to show promise for rejecting such compounds. (See also W88-07783) (Author's abstract)
W88-07791

COMPARISON OF HIGH MOLECULAR WEIGHT ORGANIC COMPOUNDS ISOLATED FROM DRINKING WATER IN FIVE CITIES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
E. S. K. Chian, M. F. Giabbi, J. S. Kim, J. H. Reuter, and F. C. Kopfler.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 181-197, 3 fig, 8 tab, 15 ref.

Descriptors: *Pollutant identification, *Comparison studies, *Organic compounds, *Water analysis, *Water quality, *Drinking water, Chemical analysis, Physical properties, Water sampling, Chromatography, Ultrafiltration, Gravimetry.

Because previously unidentifiable nonvolatile fractions of chlorinated organic compounds in drinking water are of significant health concern, the physical and chemical characteristics of these high molecular weight organic compounds isolated from drinking water in five cities (New Orleans, Philadelphia, Miami, Seattle, and Ottumwa) were compared. Following elemental analysis, spectral studies, ultrafiltration, size-exclusion chromatography, thermal gravimetric analysis, and differential thermal gravimetric analysis, the physical and chemical characteristics of all these samples indicate that they may be considered as part of a single group of natural organic compounds. However, they are still unidentifiable insofar as their molecular structures are concerned. The results of the samples from the five cities showed great similarities, indicating that it is probably acceptable to base results of toxicological testing on chlorinated humics from a limited number of drinking water sources. (See also W88-07783) (Lantz-PTT)
W88-07792

SYNTHETIC POLYMERS FOR ACCUMULATING ORGANIC COMPOUNDS FROM WATER,
Ames Lab., IA.
G. A. Junk.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 201-246, 2 fig, 2 tab, 541 ref. DOE Contract No. W-7405-Eng-82.

Descriptors: *Synthetic polymers, *Organic compounds, *Pollutant identification, *Solid phase extraction, Polymers, Water analysis, Chemical analysis, Sorption, Elution, Chromatography, Resins, Ion exchange.

The increased use of solid synthetic polymers and the advantages of this procedure compared to other approaches for determining organic components present in water are reviewed. The procedure involves sorption of the organic components present in water onto a polymer by using simple column chromatography, and subsequent removal of the sorbed components by elution with an appropriate solvent. Various polymers used for the sorption and different solvents used for elution are reviewed. The main polymers are styrene-divinylbenzenes (XAD-1, XAD-2, XAD-4, Porapaks, Chromosorbs), methacrylates (XAD-7, XAD-8), diphenyl-p-phenylene oxide propylene, bonded phases, and ion-exchange resins; the primary eluents are methanol, ethyl ether, and acetone. These solvents and polymers are discussed relative to their characteristics and applications. The methodology is ideally suited to automation and online operations. Based on the advantages of solid adsorbents, it is anticipated that solid phase extraction will gradually replace solvent extraction. It is also expected that field sampling with solid adsorbents will be used extensively for both analytical and bioassay purposes. (See also W88-07783) (Author's abstract)
W88-07793

POTENTIAL ORGANIC CONTAMINATION ASSOCIATED WITH COMMERCIALLY AVAILABLE POLYMERIC SORBENTS: CONTAMINANT SOURCES, TYPES, AND AMOUNTS,
Environmental Research and Technology, Inc., Concord, MA.
G. Hunt.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 247-265, 5 fig, 1 tab, 13 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Polymers, *Water analysis, Sorbents, Resins, Polyurethane.

Polymeric sorbents are used extensively in the isolation and preconcentration of semivolatile trace organics from aquatic matrices. These synthetic materials contain measurable or significant quantities of one or more of the following types of chemical contamination: (1) residual monomers, (2) artifacts of the polymer synthetic pathway, and (3) chemical preservatives used to inhibit chemical or biological degradation. This study provides some

insight into the chemistry of a number of commonly used polymeric sorbents. Particular focus is placed on the chemical identification of solvent-extractable semivolatile organic contaminants typically associated with each of the following types of polymeric sorbents as received from the manufacturer: Amberlite XAD resins, Ambersorb XE resins, and polyurethane foam. Amberlite XAD-2 and XAD-4 resins, for example, contain significant quantities of alkyl derivatives of benzene, styrene, naphthalene, and biphenyl as received from the supplier. Polyurethane foam products generally contain numerous contaminants peculiar to one of the several patented commercial manufacturing processes. These include, but are not limited to, the following classes of chemical contaminants: isocyanate derivatives (e.g., toluene diisocyanates), alkyl amines, aliphatic acids, and brominated aromatics (e.g., fire retardants). Rigorous sorbent pretreatment procedures (e.g., Soxhlet extraction and thermal desorption) in concert with a well-established quality control program are found to successfully control potential contamination effects arising from the sample collection media. Furthermore, a well-executed quality control program will permit identification of spurious data points attributable to media contamination when and if they do occur. (See also W88-07783) (Lantz-PTT)
W88-07794

EVALUATION OF THE PREPARATION OF RESIN SAMPLERS FOR BROAD SPECTRUM ANALYSIS OF LARGE-VOLUME SAMPLES,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. Gibs, L. Brenner, L. Cognet, and I. H. Suffet.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 267-294, 5 fig, 5 tab, 39 ref.

Descriptors: *Resins, *Chemical analysis, *Water analysis, *Pollutant identification, *Chromatography, Chemical treatment.

XAD resin cleaning by exhaustive extraction with a series of solvents was studied to observe if the resin cleaned in this manner was acceptable for use in broad spectrum capillary gas chromatographic (GC) analysis. Resin artifacts were always found in distilled water blanks after cleaning and after recleaning and reuse of the resin. The artifacts were identified by GC-mass spectrometry and compared to artifacts previously reported. Variations in artifacts were found between production lots. Several hypotheses are proposed for the existence of the resin artifacts after cleaning. Semiquantitative (order of magnitude) analysis is possible for broad spectrum analysis of resin lots cleaned by a consistent method and blanked with Milli-Q water. The concentrations of the resin impurities will vary as a function of the following: (1) The resin's exposure to a large-volume environmental sample with varying concentrations of chemicals: (2) The resin's elution procedure; (3) The resin's storage before use in methanol or sampling directly after cleaning with the eluting solvent; and (4) The resin cleaning and reuse procedure. This quality assessment study indicates that to use resins for broad spectrum analysis, the resin elution, storage, cleaning, and reuse procedures must be rigorously defined and strictly followed so that the artifacts produced do not interfere. (See also W88-07783) (Lantz-PTT)
W88-07795

ISOLATION OF ORGANIC ACIDS FROM LARGE VOLUMES OF WATER BY ADSORPTION ON MACROPOROUS RESINS,
Geological Survey, Denver, CO.
G. R. Aiken.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 295-307, 3 fig, 3 tab, 15 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Acids, *Adsorption, *Resins, Water analysis, Chemical analysis, Amberlite, Duolite, Hydrogen ion concentration, Pore size, Filtration, Membrane processes.

Adsorption on synthetic macroporous resins, such as the Amberlite XAD series and Duolite A-7, is routinely used to isolate and concentrate organic acids from large volumes of water. Samples as large as 24,500 L have been processed on site by using these resins. Two established extraction schemes using XAD-8 and Duolite A-7 resins are described. The choice of the appropriate resin and extraction scheme is dependent on the organic solutes of interest. The factors that affect resin performance, selectivity, and capacity for a particular solute are solution pH, resin surface area and pore size, and resin composition. The logistical problems of sample handling, filtration, and preservation are also discussed. (See also W88-07783) (Author's abstract)
W88-07796

USE OF LARGE-VOLUME RESIN CARTRIDGES FOR THE DETERMINATION OF ORGANIC CONTAMINANTS IN DRINKING WATER DERIVED FROM THE GREAT LAKES,
Health and Welfare Canada, Tunney's Pasture, Ottawa (Ontario). Monitoring and Criteria Div., Environmental Health Directorate.
G. L. LeBel, D. T. Williams, and F. M. Benoit.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 309-325, 1 fig, 14 tab, 12 ref. Health and Welfare Canada Contract Nos. 885 and 1084.

Descriptors: *Resins, *Pollutant identification, *Organic compounds, *Drinking water, *Great Lakes, *Water analysis, Chemical analysis, Organophosphorus, Organochlorine, Aromatic compounds, Triaryl-alkyl phosphates, Gas chromatography, Mass spectrometry.

A large-volume XAD-2 resin sampling cartridge was designed to sample approximately 1500 L of raw and treated drinking water to obtain sufficient organic water extracts for chemical analysis and biological testing. The concentration technique was evaluated for the extraction and subsequent chemical analysis of several target compounds in 1500 L of water samples fortified at 10 nanograms/L. Recoveries were >70%; these recoveries were similar to earlier recoveries employing a smaller volume cartridge. The cartridges were used to obtain water extracts from six Great Lakes area drinking water supplies, and the extracts were analyzed for organophosphorus, organochlorine, polyaromatic hydrocarbon, and triaryl-alkyl phosphate compounds by gas chromatography-mass spectrometry (GC-MS). Some of the compounds were found at nanograms/L concentrations in both raw and treated water samples. Analysis of fortified and field-water extracts by two GC-MS laboratories gave similar intra- and interlaboratory precision and accuracy data. (See also W88-07783) (Author's abstract)
W88-07797

BROAD SPECTRUM ANALYSIS OF RESIN EXTRACTS: A BASE EXTRACTION CLEANUP PROCEDURE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. Gibs, and I. H. Suffet.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 327-346, 6 fig, 2 tab, 26 ref. EPA Contract No. 806256-02.

Descriptors: *Chemical analysis, *Resins, *Pollutant identification, *Water analysis, Gas chromatography, Humic acids, Organic matter, Organic compounds.

A base extraction procedure was developed to minimize the degradation of the performance of fused-silica capillary chromatographic columns used to analyze XAD resin extracts. The degradation of the capillary gas chromatographic column was apparently caused by humic materials which were absorbed on XAD resins and eluted by nonpolar solvents along with the nonpolar organic compounds of interest in the samples. The base extraction procedure removed approximately 84% of the humic materials present in the ether extract. (See also W88-07783) (Author's abstract)
W88-07798

SOLVENT EXTRACTION USING A POLYMER AS SOLVENT WITH AN AMPEROMETRIC FLOW-INJECTION DETECTOR,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
Y. W. Feng, and C. O. Huber.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 349-357, 4 fig, 1 tab, 7 ref.

Descriptors: *Pollutant identification, *Polymers, *Amperometry, *Water analysis, Polyvinyl chloride, Solutes, Organic compounds, Flow injection, Hydrogen ion concentration, Chemical analysis.

Solvent extraction offers unique advantages among separation techniques. A system based on extraction into a polymer (poly(vinyl chloride)) as solvent was examined because of possible advantages in speed, simplicity, sample size, solvent handling, etc., especially when coupled with flow injection and an amperometric detector. Solutes examined included salicylic acid and 8-hydroxyquinoline. The apparatus typically consisted of 0.8-mm i.d. X 170-cm coiled tubing that could be connected directly to the injection loop of a flow-injection amperometric detector system containing a nickel oxide electrode. Selectivity via pH control of the extraction step and preconcentration of analyte can be accomplished. The results suggest that other polymer solvent extraction schemes can be developed by using this approach. The flow-through amperometric technique provides a well-suited detector component for the technique. (See also W88-07783) (Lantz-PTT)
W88-07799

EVALUATION OF BONDED-PHASE EXTRACTION TECHNIQUES USING A STATISTICAL FACTORIAL EXPERIMENTAL DESIGN,
Smith Kline and French Labs., Philadelphia, PA.
R. E. Hannah, V. L. Cunningham, and J. P. McGough.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 359-379, 10 fig, 6 tab, 20 ref.

Descriptors: *Chemical analysis, *Statistical analysis, *Pollutant identification, *Silicas, Water analysis, Organic compounds, Hydrogen ion concentration, Chemical properties, Sorbents.

Isolation techniques using bonded-phase silicas (bonded-phase extraction) were evaluated as an alternative to liquid-liquid extraction methods. The relative importance of four variables on extraction efficiencies for bonded-phase isolation techniques was evaluated by using a statistical 2 to the 4th power factorial experimental design (4 variables at 2 levels). Extraction efficiencies were based on percent recoveries for a 27-component synthetic test mixture containing a variety of organic compounds typical of those likely to be found in samples of interest. The experimental variables that were identified and included in the design were sample pH, nonpolar solid-phase extraction strength, polar-phase extraction strength, and conditioning solvent concentration. Analysis of data from the factorials indicates that pH has a consistently significant effect on compound recoveries. There is also an interaction between pH and primary column sorbent type for some compounds. Many of the analytes examined can be isolated by using alternate methods such as purge and trap, liquid-liquid extraction, and steam distillation. However, solid-phase extraction techniques are effective in isolating and concentrating a variety of organic compounds from aqueous matrices at trace levels. These techniques generally require less sample manipulation and are much quicker and more economical than traditional extraction proce-

dures. The use of two-level experimental factorial designs has been demonstrated to be extremely useful for measuring the effects of variables on a response. (See also W88-07783) (Lantz-PTT)
W88-07800

USE OF GEL PERMEATION CHROMATOGRAPHY TO STUDY WATER TREATMENT PROCESSES,
Lyonnaise des Eaux Central Lab., 38 rue du President Wilson 78230, Le Pecq, France.
For primary bibliographic entry see Field 5F.
W88-07801

MUTAGEN ISOLATION METHODS: FRACTIONATION OF RESIDUE ORGANIC COMPOUNDS FROM AQUEOUS ENVIRONMENTAL SAMPLES,
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
M. W. Tabor, and J. C. Loper.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 401-421, 7 fig, 1 tab, 38 ref. EPA Grant Nos. CR808603 and CR810792, and NSF Grant No. PCM-8219912.

Descriptors: *Mutagens, *Chemical analysis, *Microbiological studies, *Pollutant identification, *Organic compounds, *Water analysis, High performance liquid chromatography, Salmonella, Bioassays, Chromatography.

A general preparative procedure, based on high-performance liquid chromatography (HPLC) and the Salmonella microsome mutagenicity assay, has been developed for the isolation of mutagenic components from samples of complex mixtures of residue organics obtained from environmental waters. This procedure features preliminary HPLC separation to characterize the sample; preparative-scale HPLC separation with mutagenic bioassay of the fractions; further HPLC separation of bioactive fractions, employing different elution techniques; and chemical-biological characterization of isolated mutagenic components. When applied to residues obtained by various procedures, the method reveals a wide range of mutagenic activity among environmental waters, depending upon the source of water sample, the apparent types of natural and anthropogenic compounds the water contains, and the water-processing and disinfection procedures used for treatment. Biologically, this range of activity encompasses mutagenic components that are differentiated on the basis of tester strain specificity and the effects of the absence or presence of microsomal activation. Chemically, the various mutagenic components are separable by HPLC across the entire range of polar, midpolar, relatively nonpolar, and nonpolar compounds. Through combinations of specific mutagenic bioassays plus sequential analytical and preparative HPLC fractionations, this method is applicable for the isolation of mutagens from residues of a variety of environmental waters. (See also W88-07783) (Lantz-PTT)
W88-07802

COMPARISON OF SEVEN METHODS FOR CONCENTRATING ORGANIC CHEMICALS FROM ENVIRONMENTAL WATER SAMPLES,
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
F. C. Kopfler, H. P. Ringhand, and R. G. Miller.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 425-436, 1 fig, 4 tab, 16 ref.

Descriptors: *Potable water, *Chlorination, *Organic compounds, *Water analysis, *Pollutant identification, Organic matter, Comparison studies, Polarity, Solubility, Molecular weight, Chemical properties, Disinfection, Reverse osmosis, Resins, Solutes.

Because there are no quantitative analytical techniques for the complex organic matter that occurs in chlorinated water, direct determination of the efficiency of techniques for isolating this matter is not possible. Seven methods (one concentration technique, four isolation methods, and two combination methods) capable of isolating gram quantities of organic matter from water samples were evaluated by determining the ability of each to recover a set of model compounds possessing a wide variation in polarity, functional groups, water solubility, and molecular weight. No single method appeared to be superior overall, on the basis of the recovery of the model solutes, but some methods could be eliminated from field application for the present time because the adsorbents required were not commercially available. Field application of two methods (reverse osmosis (RO) and adsorption using XAD-8 and XAO-2 resins) was undertaken, and the samples collected were tested in several bioassays. The use of the solid resin adsoorbents was the most efficient method and showed the greatest potential in concentrating organics from potable water for biological testing. (See also W88-07783) (Author's abstract)
W88-07803

EVALUATION OF REVERSE OSMOSIS TO CONCENTRATE ORGANIC CONTAMINANTS FROM WATER,
Gulf South Research Inst., New Orleans, LA.
S. C. Lynch, and J. K. Smith.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 437-465, 6 fig, 13 tab, 21 ref. EPA Contract Nos. 68-03-2999 and 68-03-3164.

Descriptors: *Reverse osmosis, *Organic compounds, *Water analysis, Performance evaluation, Cellulose acetate, Membrane processes, Leachates.

Reverse osmosis for concentrating trace organic contaminants in aqueous systems by using cellulose acetate and Film Tec FT-30 commercial membrane systems was evaluated for the recovery of 19 trace organics representing 10 chemical classes. Mass balance analysis required determination of solute rejection, adsorption within the system, and leachates. The rejections with the cellulose acetate membrane ranged from a negative value to 97%, whereas the FT-30 membrane exhibited 46-99% rejection. Adsorption was a major problem; some model solutes showed up to 70% losses. These losses can be minimized by the mode of operation in the field. Leachables were not a major problem. Actual recoveries are reported for a field trial in which 9500 L was concentrated to 190 L. (See also W88-07783) (Author's abstract)
W88-07804

EVALUATION OF AN INTEGRATED ADSORPTION METHOD FOR THE ISOLATION AND CONCENTRATION OF TRACE ORGANIC SUBSTANCES FROM WATER,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. F. Giabbai, E. S. K. Chian, J. H. Reuter, H. P. Ringhand, and F. C. Kopfler.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 467-481, 1 fig, 4 tab, 16 ref. EPA Contract No. 68-03-3000.

Descriptors: *Adsorption, *Trace levels, *Organic compounds, *Water analysis, *Pollutant identification, Solutes, Resins, Membrane processes, Hydrogen ion concentration, Chromatography, Chemical analysis, Quantitative analysis, Fractionation.

A scheme for the isolation and concentration of dissolved trace organic substances from water for toxicological and chemical characterization was evaluated. The principle behind this scheme consists of the separation of organic solutes into fractions by adsorption onto different adsorbents (i.e., XAD-8 resin, AG MP-50 cation-exchange resin, and Carbopack B graphitized carbon black) under varying pH conditions. Test solutions containing 22 model organic substances along with inorganic salts were used to monitor process performance. High-resolution gas chromatography and high-performance liquid chromatography were employed for the quantitation of each model compound. The isolation-fractionation scheme proved to be effective for 16 out of 22 model compounds; average recoveries varied between 30% and 90%. (See also W88-07783) (Author's abstract)
W88-07805

ISOLATION OF ORGANIC COMPOUNDS PRESENT IN WATER AT LOW CONCENTRATIONS USING SUPERCRITICAL FLUID CARBON DIOXIDE,
Little (Arthur D.), Inc., Cambridge, MA.
D. J. Ehntholt, C. Eppig, and K. E. Thrun.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 483-501, 1 fig, 6 tab, 26 ref. EPA Contract No. 68-03-3001 and Arthur D. Little Project No. 85474.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, *Chemical analysis, *Carbon dioxide, Volatile compounds, Humic acids, Inorganic compounds.

The use of supercritical fluid carbon dioxide for the isolation and concentration of certain types of organic compounds present in water at low concentration levels was demonstrated. Compounds that were volatile and/or not highly soluble in water were readily extracted under the operating conditions used. However, the subsequent efficient trapping of these compounds was not a trivial problem. Those compounds that exhibited greater solubility in water (e.g., trimesic acid and 5-chlorouracil) did not show evidence of extraction; in addition, those materials that tended to precipitate (humic acid) or form more soluble species (caffeine) under acidic conditions were not extracted. Experiments were also conducted to determine whether or not inorganic salts such as sodium bicarbonate, calcium sulfate, calcium chloride, or lead nitrate (added to several solutions as surrogates for possible toxic metal salt contaminants) were extracted. Results indicated that inorganics were not isolated or concentrated. It appears that the supercritical fluid carbon dioxide extraction of organic compounds present in water at low levels may be useful only in the case of volatile organic species. Even for these compounds, however, if efficient recovery of the compounds is desired, certain limitations of existing trapping techniques remain to be overcome. (See also W88-07783) (Lantz-PTT)
W88-07806

RECOVERY OF TRACE ORGANIC COMPOUNDS BY THE PARFAIT-DISTILLATION METHOD,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
J. B. Johnston, C. Josefson, and R. Trubey.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 503-533, 6 fig, 9 tab, 18 ref. EPA Agreement No. 807126.

Descriptors: *Pollutant identification, *Organic compounds, *Parfait distillation, *Water analysis, Chemical analysis, Cations, Anions, Polytetrafluoroethylene, Humic acids, Resins, Ion exchange, Glucose, Adsorption, Quantitative analysis.

The parfait-distillation method uses a sequential series of adsorbents to remove contaminants from water and vacuum distillation to recover unadsorbed materials. This method recovers a wide range of neutral, cationic, anionic, and hydrophobic contaminants. The first adsorbent, porous polytetrafluoroethylene (PTFE), removed humic acid and a broad range of hydrophobic compounds. PTFE was followed by Dowex MSC-1 and then Duolite A-162 ion-exchange resins. A synthetic hard water spiked parts-per-billion concentrations with 20 model compounds was used to evaluate the method. Poorly volatile, neutral, water-soluble species (glucose); cationic aromatics; and most hydrophobic compounds were recovered quantitatively. Model amphoterics were removed from the

influent but were not recovered from the adsorption beds. The recovery of model acids and bases ranged from 22% to 70% of the amount applied. (See also W88-07783) (Author's abstract)
W88-07807

EVALUATION OF A QUATERNARY RESIN FOR THE ISOLATION OR CONCENTRATION OF ORGANIC SUBSTANCES FROM WATER,
Envirodyne Engineers, Inc., St. Louis, MO.
S. Ben-Poorat, D. C. Kennedy, and C. H. Byington.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 535-556, 4 fig, 4 tab, 2 ref.

Descriptors: *Quaternary resins, *Pollutant identification, *Organic compounds, *Water analysis, Chemical analysis, Performance evaluation, Resins, Adsorption, Desorption, Humic acids, Statistical analysis.

A synthetic resin (Amberlite XAD-4 quaternary) was evaluated as an adsorbent for the concentration-isolation of 22 specific organic solutes at micrograms/liter levels. Adsorption and desorption processes were first developed and tested on a laboratory scale and then adapted for a pilot-scale model. Studies determining the effect of humic substances and inorganic salts on the adsorption-desorption of model compounds were also performed. The effect of 2 ppm of chlorine residual on the generation of chlorinated organic compounds was also studied. XAD-4 quaternary resin in hydroxide form was efficient in recovering the majority of model compounds. Mass balances indicated that accountability was generally higher in bench-scale experiments. Statistical evaluation of pilot-scale studies suggested that the presence of humic substances affected the concentration of model compounds. (See also W88-07783) (Author's abstract)
W88-07808

HIGH-PERFORMANCE CONCENTRATION SYSTEM FOR THE ISOLATION OF ORGANIC RESIDUES FROM WATER SUPPLIES,
Los Angeles County Sanitation Districts, Whittier, CA. San Jose Creek Water Quality Lab.
R. B. Baird, C. A. Jacks, and L. B. Neisess.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 557-569, 2 fig, 3 tab, 35 ref. EPA Contract No. R-806399010.

Descriptors: *Pollutant identification, *Organic compounds, *Drinking water, *Water supply, *Water analysis, Membrane processes, Resins, Chemical analysis, Anions, Cations.

Recovery of nonpolar hydrophobic model compounds from a four-resin concentrator system was in the 70% range, whereas hydrophilic organic compounds were not recovered well. The concentrator system consisted of a series of 45-75 micrometer macroreticular resin columns (MP-1 (anionic), MP-50 (cationic), XAD-2 (nonionic, nonpolar), and XAD-7 (nonionic, moderate polarity)) through which 500-L water samples were pumped with a high pressure Teflon diaphragm pump. Columns were eluted with acetonitrile; ionic resin columns were also eluted with saturated NaCl, and the salt solutions were extracted with dichloromethane at neutral, acidic, and basic pH. Most model compounds were recovered from MP-1. The hydrophobic materials breaking through this column were usually found on MP-50 and XAD-2. The lower amounts of hydrophilic organics recovered were retained by XAD-2 and XAD-7. (See also W88-07783) (Author's abstract)
W88-07809

CONTINUOUS LIQUID-LIQUID EXTRACTOR FOR THE ISOLATION AND CONCENTRATION OF NONPOLAR ORGANIC COMPOUNDS FOR BIOLOGICAL TESTING IN THE PRESENCE OF HUMIC MATERIALS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
R. J. Baker, and I. H. Suffet.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 571-591, 7 fig, 5 tab, 21 ref. EPA Grant No. CR810484-01-0.

Descriptors: *Pollutant identification, *Organic compounds, *Organic matter, *Extraction, *Water analysis, *Humic matter, *Continuous liquid-liquid extraction, Hydrogen ion concentration, Regression analysis, Statistical analysis, Water sampling, Methylene chloride.

A continuous liquid-liquid extraction sampling device (CLLE) was evaluated for its ability to concentrate nonpolar organics from water into methylene chloride. CLLE recoveries were determined at pH 3 and 7 for mixtures of up to 13 compounds and compared to recoveries of separatory funnel batch extraction (batch LLE). The comparison at pH 3 was made with and without a humic substance present. Linear regression and analysis of variance showed that CLLE and batch LLE recoveries are statistically equivalent for most compounds under the conditions tested and that the presence of the humic material has similar effects on CLLE and batch LLE. CLLE sampling was reproducible and suitable for extracting nonpolar organics from water samples for use in biological testing. (See also W88-07783) (Author's abstract)
W88-07810

BIOLOGICAL TESTING OF WATERBORNE ORGANIC COMPOUNDS,
Cincinnati Univ., OH. Dept. of Microbiological and Molecular Genetics.
J. C. Loper.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 595-604, 1 tab, 40 ref.

Descriptors: *Water pollution effects, *Organic compounds, *Water analysis, *Pollutant identification, Mutagenicity, Toxicity, Humic acids, Water quality.

Increased attention to the possible adverse effects of compounds in environmental waters has been stimulated not only be detection of known toxic chemicals as contaminants, but also by evidence for the presence of multiple unknown genotoxic compounds among waterborne organics. Of numerous genetic tests, bacterial mutagenicity assays have been the most revealing. Examples are discussed which show that < 10% of such mutagens have been chemically identified. This situation is true whether the studies involved surface or groundwater, industrial wastes, or products of the chlorination of humic acids. Roles of mutagenicity testing are discussed in relation to evaluating collection procedures, examining the origin and fate of mutagens, guiding chemical fractionation of residue mixtures for compound identification, and developing criteria of water quality. (See also W88-07783) (Author's abstract)
W88-07811

CONCENTRATION, FRACTIONATION, AND CHARACTERIZATION OF ORGANIC MUTAGENS IN DRINKING WATER,
National Inst. of Public Health and Environmental Hygiene, Leidschendam, The Netherlands.
H. J. Kool, C. F. Van Kreijl, and M. Verlaan-de Vries.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 605-625, 10 fig, 1 tab, 28 ref. Netherlands Cancer Society Grant No. RID 80-1.

Descriptors: *Mutagens, *Organic compounds, *Water analysis, *Chlorination, *Drinking water, *Pollutant identification, Chemical analysis, Resins.

A combination of Amberlite XAD-4 and XAD-8 resins is very suitable for concentrating organic mutagens (Ames test positive) in drinking water. Fractionation of these mutagenic organic drinking water concentrates with the aid of Sephadex LH20 revealed that organic mutagens showed a molecular weight in the range of 100-300. The organic mutagens were able to induce chromosomal aberrations in Chinese hamster ovary (CHO) cells. Nitro organics, in part, were shown to be responsible for mutagenic activity in organic concentrates prepared from chlorinated drinking water in The Netherlands. Finally, results strongly indicate that nitro organics (halogenated or not) are introduced and/or activated in drinking water after a chlorine treatment. (See also W88-07783) (Author's abstract)
W88-07812

NEGATIVE-ION CHEMICAL IONIZATION MASS SPECTROMETRY AND AMES MUTAGENICITY TESTS OF GRANULAR ACTIVATED CARBON TREATED WASTE WATER,
Los Angeles County Sanitation Districts, Whittier, CA. San Jose Creek Water Quality Lab.
R. B. Baird, J. P. Gute, C. A. Jacks, L. B. Neisess, and M. H. Nellor.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 641-658, 9 fig, 4 tab, 29 ref.

Descriptors: *Chemical treatment, *Wastewater treatment, *Mass spectrometry, *Water analysis, *Secondary wastewater treatment, *Ames test, *Activated carbon, *Toxicity, Effluents, Organic compounds, Halides, Chlorination, Silver nitrate, Chemical reactions, Mutagens.

Granular activated carbon (GAC) removed > 70% of the TA98 mutagenicity from secondary effluent during a normal 6-week cycle. Negative-ion chemical ionization (NICI) gas chromatography-mass spectrometry (GC-MS) and silver nitrate derivatization showed that removal of labile organohalides paralleled the mutagen removal, consistent with a causal relationship. Chlorination did not consistently increase or decrease mutagenicity, although NICI showed that some silver-reactive organohalides were reduced and others were formed during chlorination. Silver reaction formation of additional compounds was also demonstrated by NICI; the number was less after either GAC or chlorination. Consistent with the results, it was hypothesized that there is a reservoir of halogenated high molecular weight material that can yield smaller electrophilics and that GAC is effective in removing much of this residue. (See also W88-07783) (Author's abstract)
W88-07814

TECHNIQUES FOR THE FRACTIONATION AND IDENTIFICATION OF MUTAGENS PRODUCED BY WATER TREATMENT CHLORINATION,
Water Research Centre, Marlow (England).
H. Horth, B. Crathorne, R. D. Gwilliam, C. P. Palmer, and J. A. Stanley.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 659-674, 6 fig, 1 tab, 16 ref.

Descriptors: *Chemical analysis, *Mutagens, *Water treatment, *Water analysis, *Chlorination, *Pollutant identification, Humic acids, Salmonella, Chromatography, High performance liquid chromatography, Resins, Amino acids.

Byproducts of the chlorination of treated water, humic acids, and amino acids were shown to be mutagenic to Salmonella typhimurium strain TA100 in the fluctuation test. A two-stage fractionation procedure, using high-performance liquid chromatography (HPLC) combined with the fluctuation test, was developed. A comparison of the mutagenic activity of extracts of water taken from a treatment works before and after final chlorina-

tion showed that only the sample after chlorination was mutagenic to bacterial strain TA100. A two-stage HPLC fractionation procedure was developed and produced a number of mutagenic fractions from the XAD-2/ethyl ether extract. This result indicated the presence of several mutagenic compounds. Chlorination of humic acids and amino acids at concentrations and conditions that simulated water treatment chlorination produced mutagenic XAD-2/ethyl ether extracts. Compounds in these extracts may, therefore, account for some of the activity observed in drinking water. Chlorination of individual amino acids showed that methionine, tyrosine, phenylalanine, tryptophan, and proline produce highly mutagenic extracts. HPLC separation of the extracts of chlorinated tyrosine and phenylalanine indicated the presence of compounds that were not amenable to analysis by GC-MS. (See also W88-07783) (Lantz-PTT)
W88-07815

NEW METHODS FOR THE ISOLATION OF MUTAGENIC COMPONENTS OF ORGANIC RESIDUALS IN SLUDGES,
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
M. W. Tabor, and J. C. Loper.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 675-689, 5 fig, 2 tab, 22 ref. EPA Contract No. CR810792.

Descriptors: *Pollutant identification, *Mutagens, *Organic compounds, *Water analysis, *Sludges, Wastewater treatment, Sodium sulfate, Bioassays, Salmonella.

A general procedure has been developed for the isolation of residue organic from sewage treatment plant sludges for mutagenic assessment. The procedure features milling the sludge with anhydrous sodium sulfate to a homogeneous powder, sequential extractions of the powder with a solvent series from nonpolar to polar, and bioassay of the extracted organics via the Salmonella microsomal mutagenicity assay. This new method was compared to published U.S. EPA procedures and solvent extraction procedures for isolating organics from sludges. Results of this study suggest that both published procedures either destroyed labile mutagens in sludges or caused the formation of mutagenic artifacts during the isolations. The new procedure features gentle isolation conditions and produces a homogeneous sample that is easily manipulated for further studies to isolate mutagens for chemical and biological characterization. (See also W88-07783) (Author's abstract)
W88-07816

INVESTIGATING THE TOXICOLOGY OF COMPLEX MIXTURES IN DRINKING WATERS,
Environmental Protection Agency, Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5C.
W88-07819

DETERMINATION OF PHENOL IN RAW AND POTABLE WATERS BY HPLC MULTI-ELECTRODE ELECTROCHEMICAL DETECTION,
North West Water Authority, Huntington W.T.W., Chester CH3 6EA, UK.
P. J. Rennie, and S. F. Mitchell.
Chromatographia CHRGB7, Vol. 24, p 319-323, 1987. 5 fig, 1 tab, 9 ref.

Descriptors: *Raw water, *Potable water, *Chromatography, *Water analysis, *Pollutant identification, *Phenols, *High-performance liquid chromatography, *Industrial wastes, Chemical properties, Rivers, Pollutants, Multi-electrode electrochemical detection, Hydrogen ion concentration, Electrodes.

A method is proposed for the determination of phenol in raw and potable waters using multi-electrode electrochemical detection HPLC (high-performance liquid chromatography). The coulometric efficiency of the electrochemical cell together with an ability to 'screen out' other electrochemically active species precludes the need for trace enrichment concentration techniques. The development work leading up to the proposed method is discussed with reference to selection of solvent pH and electrode potentials. The method has a limit of detection of 0.034 micrograms/l phenol and a total standard deviation of 0.083 micrograms/l phenol at a phenol concentration of 1.048 micrograms/l phenol in river water. (Author's abstract)
W88-07942

OPTICAL ABSORBANCE OF DISSOLVED ORGANIC MATTER IN NATURAL WATER STUDIES USING THE THERMAL LENS EFFECT,
Chemistry Dept., Concordia University, 1455 West de Maisonneuve Boulevard, Montreal, Quebec, Canada H3G 1M8.
For primary bibliographic entry see Field 2K.
W88-07949

SINGLE-LABORATORY EVALUATION OF METHOD 8080 - ORGANOCHLORINE PESTICIDES AND PCBS,
Acurex Corporation, Mountain View, CA 94039.
V. Lopez-Avila, S. Schoen, and J. Milanes.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-232591. Price codes: A10 in paper copy, A01 in microfiche. August 1987. 237 p, 18 fig, 48 tab, 17 ref, 3 append. US EPA Contract No. 68-03-3226. Report No. EPA/600/4-87/022.

Descriptors: *Pesticides, *Polychlorinated biphenyls, *Gas chromatography, *Chemical analysis, *Pollutants, Organic matter, Separation techniques, Organochlorine pesticides, Liquid wastes, Solid wastes, Soils, Sediments.

Method 8080 was developed for the determination of certain organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in liquids and solids including soil, sediments, and liquid and solid wastes. Liquid samples are extracted according to Method 3510 (separatory funnel) or Method 3520 (continuous liquid-liquid extractor) and solid samples according to Method 3540 (Soxhlet extraction) or Method 3550 (sonication), the extracts are concentrated, fractionated on Florisil and the fractions analyzed by gas chromatography (GC) on packed columns. The Method 8080 protocol has been evaluated in a single laboratory on actual and simulated wastes. It was found that the Florisil cleanup method is problematic when both OCPs and PCBs are present; a cleanup and fractionation on deactivated silica gel is more advantageous. Sulfur in extracts can be removed with tetrabutylammonium sulfite. Toxaphene and chlordane pose special problems because of their multiple-peak responses. The use of capillary columns instead of packet columns in the GC analysis is advantageous because better separations are obtained for complex samples containing combination of OCPs, PCBs, and other organics. The Method 8080 protocol was revised, and several features were added or changed, including the cleanup and fractionation procedures which now specify deactivated silica gel, and the use of capillary columns instead of packed columns. The revised protocol was evaluated by using extracts of environmental samples spiked with the substances of interest of known concentrations. The precision and accuracy results indicate that the revised Method 8080 can be reliably applied to the determination of organochlorine pesticides and PCBs in liquid and solid matrices. (Author's abstract)
W88-07962

IMPROVED METHOD FOR THE SIMULTANEOUS DETERMINATION OF 224-RA, 226-RA AND 228-RA IN WATER, SOILS AND SEDIMENTS,
Argonne National Lab., IL.
H. F. Lucas.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011415. Price codes: A02 in paper copy, A01 in microfiche. Report No. CONF-8704123--2, (1987). 7 p, 3 tab, 22 ref. DOE Contract No. W-31-109-Eng-38.

Descriptors: *Pollutant identification, *Radium radioisotopes, *Water analysis, *Chemical analysis, Soil analysis, Sediments, Resins, Statistical analysis, Cation exchange, Least squares methods.

The naturally occurring concentrations of radium (226-Ra and 228-Ra) in public and private water supplies have been studied for many years. Both general surveys and local studies have established the geographical regions where well waters exceed 3 pCi/L. In general, the 226-Ra was determined by the emanation method, while the 228-Ra was determined from the beta activity of the 228-Ac daughter. The retention of radium on a normal cation exchange resin depends on the volume and hardness of the water, as well as the flow rate. Before the 'Radium Selective Complexer' was available, other resins were used to concentrate the radium. The retention of radium on the Radium Selective Complexer is considerably better than for the Dowex 50 cation exchange resin. In fact, the retention on as little as 10 ml of resin was equal to that for 200 ml of Dowex 50. While it is expected that conditions will be found in which the radium retention will be reduced, this should not occur for potable waters. The accuracy and precision of the least squares radium analysis was determined by adding known amounts of 226-Ra and 228-Ra to 20 L of tap water. The amounts found are within normal statistical limits of the amount added. It is concluded that the accuracy of this method can approach + or - 2% and that the limit of sensitivity is about 0.5 pCi/L for 226-Ra and 228-Ra. (Lantz-PTT)
W88-07965

ROCKWELL HANFORD OPERATIONS ENVIRONMENTAL SURVEILLANCE: ANNUAL REPORT, CALENDAR YEAR 1986,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 5B.
W88-07970

IN SITU DETECTION OF ORGANICS,
Lawrence Livermore National Lab., CA.
P. F. Daley, F. P. Milanovich, M. Angel, T. Kulp, and D. Garvis.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 153-167, 11 fig, 3 ref.

Descriptors: *In situ tests, *Pollutant identification, *Organic compounds, Measuring devices, Water analysis, Chemical analysis, Hydrogen ion concentration, Optical instruments.

A portable, remote, chemical-sensing technology based on optically active chemical probes (optrodes), fiber optics, and advanced phase-sensitive optical detection has been demonstrated. The latest generation of fiber optic instrument and complete data acquisition system can be transported by a single person and is easily modified in the field to perform different sensing tasks. Two optrodes are described in detail: a reservoir type under development for analysis of halogenated volatile organics and a polymer-coated probe for pH. The extension of these optrode designs to other applications is discussed. (See also W88-07971) (Author's abstract)
W88-07976

5B. Sources Of Pollution

CHANGES OF WATER TEMPERATURE, PH, DISSOLVED OXYGEN, INORGANIC NITROGEN, AND PHOSPHORUS CONCENTRATIONS IN FLOWING IRRIGATION WATER ON PADDY SURFACE,
First Laboratory of Soil and Fertilizer, Environment Div., Chugoku Nat. Agricultural Experiment Station, Fukuyama, Hiroshima, 721 Japan.
A. Ito.
Soil Science and Plant Nutrition, Vol. 33, No. 3, p 449-459, 1987. 6 fig, 2 tab, 7 ref.

Descriptors: *Water temperature, *Fate of pollutants, *Nutrients removal, *Hydrogen ion concentration, *Dissolved oxygen, *Nitrogen, *Phosphorus, *Flood irrigation, *Irrigation water, *Rice, Diurnal distribution, Water quality, Japan, Self-purification.

The changes in the quality of irrigation water were investigated while water was flowing on the surface of planted and bare paddy fields during the day and at night. The temperature and pH of the water on the surface of the planted field increased with the flowing process in the daytime, during the early growth stage of the rice plant, but varied very little after the middle growth stage as a result of shading by rice plants. In the bare field, the water temperature usually increased while water was flowing, throughout the growth period of the rice plant. At night, the temperature of the flowing water decreased in both fields and the pH changed little during the flowing process. The concentration of dissolved oxygen in the flowing water increased when enough sunlight reached the surface of both the planted and the bare field. In the planted field shaded by rice plants and at night, the amount of oxygen dissolved changed little while water was flowing. The contents of ammonium and total inorganic nitrogen in the flowing water decreased on the surface of both fields during the day and at night. In the planted field, the rates of decrease of the ammonium nitrogen content during the flowing process at 150 m varied from 20 to 38% in the daytime and from 8 to 37% at night. In the bare field, the average rate of decrease of the content of ammonium nitrogen was 76% in the daytime and 20% at night. The amount of inorganic phosphorus in the water decreased while water was flowing on the surface of the paddy fields. The rates of decrease of the amount of inorganic phosphorus were more or less the same between day and night in both the planted and the bare fields. (Author's abstract)
W88-06827

LONG-TERM SURVIVAL OF ESCHERICHIA COLI IN RIVER WATER,
Dept. of Biological Sciences, Univ. of Warwick, Coventry CV47AL, UK.
K. P. Flint.
Journal of Applied Bacteriology JABAA4, Vol. 63, No. 3, p 261-270, September 1987. 5 fig, 1 tab, 28 ref.

Descriptors: *Bacteria, *Survival, *Coliforms, *Plasmids, *Competition, *Microbiological studies, *Riparian waters, *Water temperature, Population density, Autoclaves, Filtration, Antiobiotics, Deficient nutrients, Starvation.

Escherichia coli introduced into autoclaved filtered river water survived for up to 260 d at temperatures from 4 to 25 C with no loss of viability. Survival times were less in water which was only filtered through either a Whatman filter paper or a 0.45 micrometer Millipore filter or in untreated water, suggesting that competition with the natural microbial flora of the water was the primary factor in the disappearance of the introduced bacteria. Survival was also dependent upon temperature with survival at 4 C > 15 C > 25 C > 37 C for any water sample. Direct counts showed that bacterial cells did not disappear as the viable count decreased. The possession of the antibiotic resistance plasmids R1drd-19 or R144-3, did not enhance survival nor cause a faster rate of decay, indicating that the metabolic burden imposed by a plasmid was not a factor in survival under starvation conditions. There was no evidence of transfer of either plasmid at 15 C or of loss of plasmid function during starvation. (Author's abstract)
W88-06834

FREQUENCY OF ERWINIA CAROTOVORA IN THE ALYTH BURN IN EASTERN SCOTLAND AND THE SOURCES OF THE BACTERIUM,
Scottish Crop Research Inst., Invergowrie, Dundee DD2 5DA, UK.
M. C. M. Perombelon, and L. J. Hyman.
Journal of Applied Bacteriology JABAA4, Vol. 63, No. 4, p 281-291, October 1987. 2 fig, 7 tab, 30 ref.

Descriptors: *Pathogenic bacteria, *Coliforms, *Microbiological studies, *Nonpoint pollution sources, *Path of pollutants, *Riparian waters, *Population density, *Contamination, *Water pollution sources, *Potatoes, Water temperature, Scotland, Spatial distribution, Bacteria.

Contamination of the Alyth Burn by Erwinia carotovora was monitored monthly over 2 years at nine sites spread over a distance of ca 20 km. The bacterium was detected only once in the upper reaches of the river where it flows in uninhabited moorland but frequency of detection and contamination level tended to increase progressively as the river flowed through the middle reaches mostly in grassland to the lower reaches in arable land where the bacterium was almost always present. Erwinia populations rose from < 100 cells/L before May to frequently > 1000 but < 10000 cells/L thereafter at sites in the arable land zone. A similar pattern was found in the grassland zone except that erwinia numbers were lower. Erwinia numbers at one site in the arable land zone were positively and negatively correlated with the river water temperature and flow rate respectively when there was a 1 month lag between the environmental data and the population recorded. More than 80% of isolates tested were E. carotovora subsp. carotovora. Water from field drains in arable fields, especially those recently planted with potatoes, was frequently contaminated by E. carotovora, with numbers and a temporal pattern similar to those of the Alyth Burn. Drainage water from non-arable fields was rarely contaminated. Infected and rotting potatoes deposited in rivers temporarily contaminated the water. Survival of E. carotovora in dilute phosphate buffer was greater at pH 5.7 than at pH 7.7 and they survived for at least 10 d in river water. (Author's abstract)
W88-06835

SPECIFIC IDENTIFICATION OF SYNTHETIC ORGANIC CHEMICALS IN RIVER WATER USING LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION COUPLED WITH ELECTRON IMPACT, CHEMICAL IONIZATION AND ACCURATE MASS MEASUREMENT GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W88-06844

PETROLEUM HYDROCARBONS IN THE MARINE BIVALVE VENUS VERRUCOSA: ACCUMULATION AND CELLULAR RESPONSES,
Science Dept., Univ. of Malta, Msida, Malta.
V. Axiak, J. J. George, and M. N. Moore.
Marine Biology MBIOAJ, Vol. 97, No. 2, p 225-230, February 1988. 4 fig, 2 tab, 22 ref.

Descriptors: *Path of pollutants, *Oil pollution, *Hydrocarbons, *Mollusks, *Venus verrucosa, *Bioaccumulation, *Water pollution effects, *Crude oil, *Histology, *Animal physiology, *Animal tissues, *Toxicity, Benthic fauna, Gills, Malta, Tissue analysis.

Cellular and subcellular responses of the marine burrowing bivalve Venus verrucosa collected from the northeastern coastline of Malta from January to June 1985, after exposure to petroleum hydrocarbons (PHC) were investigated. After long-term exposure to 100 micrograms/L of water-accommodated fractions (WAF) of crude oil, PHC were found to accumulate most rapidly in the digestive gland and then in the gills, with saturation levels being reached within 100 d of exposure in both cases. PHC accumulation, both in the mantle and muscle tissues, was more gradual and consistent throughout the whole exposure period. After 150 d of exposure, the digestive cells of the digestive gland were significantly reduced in height (atrophy) and exhibited reduced lysosomal membrane stability. After 144 d of exposure to higher concentrations of PHC (820 and 420 micrograms/L), several cytological effects were recorded, including an increase in cell volume and activity of gill mucocytes as well as in the number of haemocytes in gill blood sinuses. There was also evidence of damage to the epithelial lining of the foot, stomach and style sac and marked atrophy of the digestive cells of the digestive gland. (Author's abstract)
W88-06843

TRACE METAL CONCENTRATIONS IN MUSSELS: COMPARISON BETWEEN ESTUARINE, COASTAL AND OFFSHORE REGIONS IN THE SOUTHEASTERN NORTH SEA FROM 1983 TO 1986,
Institut fur Hydrobiologie und Fischereiwissenschaft, Zeiseweg 9, D-2000 Hamburg 50, Federal Republic of Germany.
For primary bibliographic entry see Field 5A.
W88-06862

SWELL MODEL OF THE GERMAN BIGHT,
Deutsches Hydrographisches Inst. Hamburg (Germany, F.R.).
J. W. Dippner.
Coastal Engineering COENDE, Vol. 11, No. 5/6, p 527-538, December 1987. 6 fig, 16 ref.

Descriptors: *Bights, *Water currents, *Waves, *Water circulation, *Mathematical models, *Model studies, *Path of pollutants, *Tidal currents, Mathematical equations, Mathematical studies, German Bight, Momentum transfer, Energy dissipation, Wave action, Fate of pollutants, Surface pollutants.

A numerical model was used to investigate the contribution of wave-induced currents to the tidal residual circulation in the German Bight. The momentum transfer, by swell decaying to the mean circulation, is calculated including wave-current interaction without refraction. The model couples deep-water and shallow-water energy dissipation mechanisms such as wave attenuation and wave breaking. The model computes wave set-up, wave set-down and a longshore current. The pure wave-induced circulation is calculated, and also the residual circulation due to the interaction between waves and tide. The results suggest that the wave-induced currents can be neglected for the calculation of transport of near-surface pollutants. (Author's abstract)
W88-06864

FATE OF ORGANIC CARBON AND NITROGEN IN EXPERIMENTAL MARINE SEDIMENT SYSTEMS: INFLUENCE OF BIOTURBATION AND ANOXIA,
Odense Univ. (Denmark). Biological Inst.
E. Kristensen, and T. H. Blackburn.
Journal of Marine Research JMMRAO, Vol. 45, No. 1, p 231-257, February 1987. 10 fig, 6 tab, 52 ref.

Descriptors: *Organic carbon, *Nitrogen, *Fate of pollutants, *Marine sediments, *Sediments, *Detritus, Bioturbation, Anoxia, Decomposition, Mineralization, Sediment-water interfaces, Nitrification, Denitrification, Degradation.

The decay rate of particulate organic carbon (POC) and nitrogen (PON) was followed during 94 days in three homogenized sediment microcosms: (1) with a natural density of the polychaete Nereis virens (NOx-cores); (2) defaunated, with an aerobic water phase (Ox-cores); and (3) defaunated, with an anaerobic water phase (An-cores). In all cores there was a marked preferential mineralization of PON compared to POC. The presence of Nereis increased the net decomposition of POC and PON 2.6 and 1.6 times relative to Ox-cores. Ventilation of burrow structures by the worms increased the flux of O2, TCO2 and DIN across the sediment-water interface 2.5-3.5 times. This significantly decreased the pore water concentrations of TCO2 and DIN. Similarly, nitrification and denitrification were stimulated 2.3-2.4 times due to nereid activity. Oxygen did not increase organic degradation; in fact, the decay of POC and PON was faster in An- than OX-cores, 1.5-1.6 and 1.2 times, respectively. Sulfate reduction, measured at the end of the experiment, was low in the

aerobic NOx- and Ox-cores relative to An-cores. Net ammonium production measured at the end of the experiment agreed with the mean loss of PON for Ox- and An-cores, but was low for NOx-cores, suggesting that a high C:N substrate was being degraded in these cores at the end. An empirical model describing the temporal decay pattern of POC and PON is presented: the detritus in all cores were initially composed of two fractions (similar C:N); a readily degradable and a low degradable fraction. A substantial part of the degradable fraction in NOx-cores was used during the experiment, with nitrogen being mineralized preferentially. The mean C:N molar ratio of detritus was 5.9, compared to a value of 15.5 determined at the end. The Ox- and An-cores, however, showed similar C:N ratios for the detritus used during the experiment (3.7 and 4.8) and that measured at the end (4.2 and 4.6). Presumably not all the low C:N detritus had yet been mineralized in these cores at the end of the experiment. (Author's abstract)
W88-06865

RELATIVE MOBILITY OF RADIOACTIVE TRACE ELEMENTS ACROSS THE SEDIMENT-WATER INTERFACE IN THE MERL MODEL ECOSYSTEMS OF NARRAGANSETT BAY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
P. H. Santschi, M. Amdurer, D. Adler, P. O'Hara, and Y.-H. Li.
Journal of Marine Research JMMRAO, Vol. 45, No. 4, p 1007-1048, November 1987. 9 fig, 4 tab, 63 ref. NSF Grant OCE 81-11953. NOAA Grant NARAD 00016. EPA Grant 806072020.

Descriptors: *Fate of pollutants, *Narragansett Bay, *Radioactive tracers, *Tracers, *Path of pollutants, *Trace elements, *Sediment-water interfaces, *Coastal waters, *Bays, Radioactive trace elements, Heavy metals, Ecosystems, Cesuim, Cobalt, Manganese, Zinc, Ten, Iron, Mercury, Chromium.

The 'mobilities' of radioactive trace elements across the water sediment boundary of a coastal marine ecosystem were investigated. The studies included chemical speciation experiments of the solution and solid phases, and as verification experiments in controlled model ecosystems. The latter included backdiffusion experiments under oxic and anoxic conditions and experiments with artificially increased sediment resuspension rates. The backdiffusion of Cs, Mn, Co, and Zn radiotracers across the sediment-water interface into oxic waters and of Mn and Co radiotracers into anoxic waters was predicted from laboratory experiments. The removal from the water and the partial immobilization in the sediments of Cs, Zn, and Cd tracers, during anoxic conditions, agreed with results from selective leaching experiments of surface sediments with dithionite-citrate solution, a mild reducing agent which can reprecipitate liberated metals as sulfides. Radioisotopes of particle-reactive elements (Sn, Fe, Hg, and Cr) were involved in the dynamic cycle of colloid formation and aggregation in the water column and sediments. To extend the information on nuclide behavior gained from radiotracer methods to stable trace elements, stable metals were added to one tank. The removal rates and extent of uptake by suspended particles of radiotracers and their stable metal counterparts in the water column were similar. Increased resuspension rates without concomitant increased bioturbation rates had only small effects on removal rates of the radiotracers. Sediment profiles of the tracers revealed both seasonal and element-specific differences in mobility near the sediment interface. Se and Cr nuclides, which were added in different oxidation states to different tanks, showed that the higher oxidation state forms are removed more slowly from the water column than the lower oxidation state forms. (Author's abstract)
W88-06868

SIMULTANEOUS EXPOSURE OF ENGLISH SOLE (PAROPHRYS VETULUS) TO SEDIMENT-ASSOCIATED XENOBIOTICS: PART 2-CHRONIC EXPOSURE TO AN URBAN ESTUARINE SEDIMENT WITH ADDED H3-BENZO(A)PYRENE AND C14-POLYCHLORINATED BIPHENYLS,

Environmental Conservation Division, Northwest and Alaska Fisheries Center, 2725 Montlake Boulevard East, Seattle, Washington 98112.
J. E. Stein, T. Hom, E. Casillas, A. Friedman, and U. Varanasi.
Marine Environmental Research MERSDW, Vol. 22, No. 2, p 123-149, 1987. 6 fig, 4 tab, 42 ref.

Descriptors: *Hydrocarbons, *Polychlorinated biphenyls, *Path of pollutants, *Fish, *Estuarine sediments, *Bioaccumulation, Fate of pollutants, Sediments, Aromatic compounds, Benthic fauna, Sole, Aquatic animals, Metabolites, Metabolism, Radioisotopes, Radioactive tracers.

Using various chemical analytical techniques such as GC analyses of liver and HPLC/fluorescence analyses of bile, it was demonstrated that aromatic hydrocarbons (AHs) and polychlorinated biphenyls (PCBs) deposited in an urban (test) sediment by natural processes were bioavailable to a benthic flatfish, English sole (Parophrys vetulus). Benzo(a)pyrene (BaP) labelled with tritium and C-14 labelled PCBs were also added to the test sediment to compare the uptake and metabolism of BaP to that of PCBs by the sole. The amount of BaP metabolized to reactive metabolites was greater than that for PCBs, even though the concentration of C14-PCBs in the liver of test sole was five times as great as that of H3-BaP. Trace amounts of H3-BaP were also added to the reference sediment to determine how simultaneous exposure of English sole to those contaminants already present in the test sediment affected the metabolism and disposition of BaP; formation and accumulation of potentially toxic metabolites of a carcinogenic AH (BaP) in sole liver increased. (Wood-PTT)
W88-06870

HEAVY METAL ABUNDANCES IN THE KANDY LAKE-AN ENVIRONMENTAL CASE STUDY FROM SRI LANKA,

Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.
C. B. Dissanayake, A. M. Rohana Bandara, and S. V. R. Weerasooriya.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 2, p 81-88, 1987. 10 fig, 3 tab, 9 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Lakes, *Heavy metals, Metals, Kandy Lake, Sri Lanka, Iron, Vanadium, Sulfates, Lead, Cadmium, Drinking water.

Kandy Lake, located in the heart of a densely populated city of 120,000, in Sri Lanka, is a sink for surface runoff and for domestic and industrial waste matter carried by effluent canals. The lake is also a source of drinking water. Heavy metal concentrations were determined at 66 locations throughout the 1000-meter long and 100-to-300-meter wide lake. Total iron concentrations averaged 130 microgram/liter, which does not exceed WHO recommendations for drinking water. Higher Fe(++) concentrations were found offshore; higher total iron, onshore near the drain inlets. Concentrations of sulfates (0 to 32 ppm) were lowest in the offshore regions, indicating more reducing conditions. Vanadium levels (6 to 32 microgram/liter) increased toward offshore. Average lead and cadmium concentrations were 150 and 77 microgram/liter, respectively. Both were higher than the WHO recommended levels of 100 and 10 microgram/liter for lead and cadmium. Highest concentrations of these metals were found in onshore areas. Although some of the iron and vanadium content was derived from natural geologic sources, lead and cadmium pollution was associated with zinc-based small industries as well as vehicular exhaust in the case of lead. (Cassar-PTT)
W88-06877

TRACE ELEMENTS IN SURFACE SEDIMENTS OF NAVARINO BAY, GREECE,

Department of Geology, University of Patras, Patras, Greece.
S. P. Varnavas, A. G. Panagos, and G. Laios.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 3, p 159-168, 1987. 13 fig, 2 tab, 22 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Estuaries, *Trace elements, *Heavy metals, *Sediments, Bays, Navarino Bay, Greece, Metals, Yalovas River, Xerias River, Wastewater pollution, Zinc, Copper, Organic matter, Silicon, Aluminum, Cobalt, Nickel, Tin, Rubidium, Yttrium, Gallium, Food-processing wastes, Municipal wastewater, Spatial distribution.

The distribution and sources of trace elements in Navarino Bay (Greece) surface sediments were determined. Highest concentrations of these substances were as follows: (1) Zinc and copper, 352 and 66 ppm, respectively, at the effluent outfalls of a distillery and an olive oil and olive kernel factory at the port of Yalova; (2) Nickel, 151 ppm, near the town of Pylos; this was attributed to weathering of Ni-enriched bauxite deposits rather than to human activity; (3) Rubidium and yttrium, 234 ppm and 27 ppm, respectively, at the river mouths; (4) Organic matter, 6.38%, near Pylos, derived from domestic sewage. Aluminum levels were 1.2% to 6.3%, decreasing from the center and deepest part of the bay, except for high levels on the Sphaktiria coast. Silicon comprised 20-25% of the sediment, lowest on the eastern coastline of Sphaktiria and near Pylos and highest on the northern coastline of the bay. Cobalt levels (13-29 pm) were strongly correlated with Al levels, suggesting a common lithological derivation. Tin levels (2-5 ppm) and gallium levels (17-19 ppm) showed very little spatial variation. (Cassar-PTT)
W88-06881

APPLICATION OF A CONTINUOUS DISTRIBUTION MODEL FOR PROTON BINDING BY HUMIC ACIDS EXTRACTED FROM ACIDIC LAKE SEDIMENTS,

J. R. Rhea, and T. C. Young.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 3, p 169-173, 1987. 3 fig, 2 tab, 14 ref. Clarkson University Grant No. RP2237-LAMP.

Descriptors: *Acid rain effects, *Fate of pollutants, *Lakes, *Acidic water, *Humic acids, *Sediments, *Proton binding, Model studies, Cranberry Pond, New York.

A multiligand distribution model was applied to the study of proton binding characteristics of humic acids extracted from sediments of an acidic water body (pH <5.0), Cranberry Pond, New York. The model characterized a class of proton binding sites by mean log K values and the standard deviations of log K values about the mean. Average dissociation constants identified three ligand classes: Class I, a highly acidic carboxyl group; Class II, a moderately acidic carboxyl group; and Class III, phenolic groups. Results compared favorably with alkimetric titration. The model accurately predicted proton binding by humic acids for pH values in the range 3.5 to 10.0. (Cassar-PTT)
W88-06882

SUSPENDED SEDIMENT TRANSPORT, SEDIMENTATION, AND RESUSPENSION IN LAKE HOUSTON, TEXAS: IMPLICATIONS FOR WATER QUALITY,

Rice Univ., Houston, TX. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W88-06883

TRACE ELEMENT DISTRIBUTION IN WATERS OF THE NORTHERN CATCHMENT AREA OF LAKE KINNERET, NORTHERN ISRAEL,

Geochemistry Division, Geological Survey of Israel, 30 Malkhe Israel Street, Jerusalem 95501, Israel.
A. Sandler, I. B. Brenner, and L. Halicz.

Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 35-44, February 1988. 4 fig, 3 tab, 24 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Lakes, *Trace elements, *Heavy metals, Metals, Lake Kinneret, Israel, Water quality, Jordan River.

Thirty-three water sources in the Lake Kinneret watershed were sampled during 1978-1983. With the major water sources, Dan and Banias springs representing background values, the effects of human activity was evidenced by increases in trace element concentrations as the water flows through the Hula Basin and Jordan River. Concentrations of major elements (those occurring at levels of <0.5 mg/liter) with respect to spatial distribution stayed within narrow ranges and had small temporal fluctuations. These included Ca, Mg, Na, K, bicarbonate, Cl, sulfate, nitrate, and SiO2. On the other hand, spatial distribution of trace element levels (Al, Ba, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sr, V, and Zn) varied by 3 orders of magnitude, and temporal variations were large but not necessarily seasonal. With a few isolated exceptions, trace element levels did not exceed criterial levels established for drinking and irrigation water. Three main sources of trace elements were identified: industrial effluents from the town of Qiryat Shemona, fishpond wastes, and drainage from reclaimed peat soils. South of the Hula Basin the Jordan River becomes more aerated, and levels of some trace metals were lower. Factors which could increase pollutant loads entering Lake Kinneret are increased water consumption, recycling, influx of low pH and Eh effluents, and modification of channel morphology in the final segment of the Jordan. (Cassar-PTT)
W88-06884

STUDY OF METAL SORPTION/DESORPTION PROCESSES ON COMPETING SEDIMENT COMPONENTS WITH A MULTICHAMBER DEVICE,
University of Technology Hamburg-Harburg, Eissendorferstrasse 38, D-2100 Hamburg, 90, West Germany.
W. Calmano, W. Ahlf, and U. Forstner.
Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 77-84, February 1988. 7 fig, 16 ref.

Descriptors: *Path of pollutants, *Bioconcentration, *Algae, *Fate of pollutants, *Measuring instruments, *Sediments, *Heavy metals, *Sorption, Kinetics, Metals, Cadmium, Copper, Manganese, Nickel, Zinc.

A new multichamber device was developed to study sorption/desorption reactions of metals on different competing sediment components and the influence of environmental factors on these reactions. The system consists of a central chamber connected with six external chambers and separated by 0.45-micron-diameter membranes. The diffusion kinetics of metals between the single chambers were determined. Equilibrium was attained within 24 hours. Algal cell walls (Scenedesmus quadricauda), bentonite, aluminum oxide, manganese oxide, quartz powder,and goethite were used as model sediment components. Determination of metal sorption on the solid phases resulted in a significant enrichment on the algal cell walls, particularly for Cu and Cd. It was concluded that sorption depends not only on ion exchange but also on complexing reactions which lead to relatively stable surface binding. A second series of experiments investigated the effect of seawater on sediment components and dredged mud. Cadmium was remobilized from all solid components, but Cu was not remobilized from algal cell walls and bentonite. The dominant role of organic substrates in the binding of metals such as Cd and Cu is of particular relevance for the transfer of these elements into biological systems. Even relatively small percentages of organic substrates, if involved in metabolic processes, may constitute a major pathway by which metals are transferred within the food chain. (Author's abstract)
W88-06885

NITRATE ENHANCEMENT OF NITRIFICATION DEPTH IN SEDIMENT/WATER MICROCOSMS,
Oxford Univ. (England). Soil Science Lab.
J. G. Cooke, and R. E. White.
Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 85-94, February 1988. 8 fig, 30 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Streams, *Nitrates, *Sediments, *Nitrification, Ammonia, Model studies, Denitrification, Agricultural runoff, Dissolved oxygen.

Laboratory microcosms were used to study nitrogen transformations in the sediments from the River Dorn, England, which drains an agricultural catchment. Solutions of either 0.5 mmol/cu dm calcium nitrate or calcium chloride (control) were passed once only over the sediment surface. After 5 days incubation,Eh in the nitrate treatment stabilized at approximately 500 mV at 5 mm below the water/sediment interface, and 285 mV at 10 mm, whereas in the chloride treatment Eh was -200 mV to -250 mV at all measured depths (5 mm and below). Inorganic nitrogen measurements of the sediment profiles showed that much more ammonium-N was being lost from the nitrate-treated sediment than the control. It is believed that when nitrate was present in the water, the combined processes of nitrate diffusion and denitrification consumed organic matter, thereby allowing dissolved oxygen to diffuse further into the sediment. This would produce a greater depth of nitrification and more ammonium loss. A deterministic model was constructed to evaluate the hypothesis. The model stimulated the nitrate and ammonium profiles from the processes of diffusion, denitrification, nitrification, and ammonification. Kinetic parameters and diffusion impedance factor were determined from independent experiments. This model provided reasonable simulations of experimental data obtained from an additional experiment, which also showed that peaks in denitrification and nitrification activity were offset from each other by 2-3 mm, and that they migrated down the profile with increasing incubation time. (Cassar-PTT)
W88-06886

VARIABILITY OF THE METAL CONTENT OF FLOOD DEPOSITS,
Department of Geography, State University of Utrecht, The Netherlands.
H. Lennaers, C. J. Schouten, and M. C. Rang.
Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 95-106, February 1988. 7 fig, 7 tab, 18 ref.

Descriptors: *Path of pollutants, *Industrial wastewater, *Fate of pollutants, *Flood plains, *Heavy metals, , *Rivers, Metals, *Sediments, Meuse River, Geul River, Lead, Zinc, Cadmium, Copper, Cobalt, Chromium, Nickel, Soil erosion.

Fresh flood sediments were sampled in the flood plains of the River Meuse, with a catchment area of 33,000 sq km, and the River Geul, with a catchment area of 3,000 sq km. Both rivers have a history of severe metal pollution, especially with zinc, lead, and cadmium. The Geul flows into the Meuse. The flood deposits of both rivers were heterogenous mixtures of contaminated bottom sediments and clean sediments from soil erosion on agricultural cropland. Sediment was also derived from highly contaminated stream bank deposits from centuries-old zinc and lead mining activity, especially in the Geul River. Metals in the Meuse, found mostly in the clay fraction, originated from liquid industrial wastes. Average metal concentrations (ppm) in the Meuse after a 50-year flood were as follows: Pb, 220; Zn, 832; Cd, 7.6; Cu, 71; Co, 20; Cr, 37; Ni, 38. Metals levels (ppm) in the Geul after a high flood were as follows: Pb, 421; Zn, 1835; Cd, 3.4; Cu, 12; and no Co, Cr, or Ni detected. Similar measurements (ppm) in Geul sediment at low flow were as follows: Pb, 428; Zn 1382; Cu, 4.1; and no Cu, Co, Cr, or Ni detected. The positive correlation between textural composition, organic matter content, and heavy metal concentration which is often reported was not observed in this study. Normalization of the metal content was not possible. Metals concentrations in sediments decreased along the length of the Geul, reflecting the point source of the pollution, the upstream metal mines. No clear pattern of metal level decrease was seen in Meuse sediments because many industrial effluents are discharged throughout the river course. (Cassar-PTT)
W88-06887

SEASONAL VARIATIONS IN THE LOOSELY SORBED PHOSPHORUS FRACTION OF THE SEDIMENT OF A SHALLOW AND HYPEREUTROPHIC LAKE,
Aarhus Univ. (Denmark). Botanical Inst.
M. Sondergaard.
Environmental Geology and Water Sciences EGWSEI, Vol. 11, No. 1, p 115-121, February 1988. 5 fig, 2 tab, 18 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Lakes, *Phosphorus, *Sediments, *Seasonal variation, Lake Sobygaard, Denmark, Absorption, Eutrophic lakes, Shallow lakes, Lake sediments, Hydrogen ion concentration.

Loosely adsorbed phosphorus (AP) was shown to constitute much of the total phosphorus in the P-rich near-surface sediments of Lake Sobygaard, Denmark. The small, hypereutrophic lake with 0.4 sq km area and mean depth of 1 m had total phosphorus levels of 0.2-0.8 mg/liter in water and up to 12 mg/g DW in the surface sediment. Concentrations (in mg/g DW) of AP were 0.2 in winter to <2 in summer. Most of the seasonal variation occurred in the upper few cm of sediment. During the summer, intense photosynthetic activity caused pH elevations to 10-11 in the water column and to 9-10 in pore water. Winter pH was about 8 in the water column and 7.5-8.5 in the sediment. This pH increase was associated with the AP levels. (Cassar-PTT)
W88-06889

ACCUMULATION, DEGRADATION AND BIOLOGICAL EFFECTS OF LINDANE ON SCENEDESMUS OBLIQUUS (TURP.) KUTZ,
Research Institute of Environmental Chemistry, Academic Sinica, Beijing, China.
For primary bibliographic entry see Field 5D.
W88-06899

VERTICAL NUTRIENT TRANSPORT AND ITS EFFECTS ON EPILIMNETIC PHOSPHORUS IN FOUR CALCAREOUS LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 2H.
W88-06904

HEAVY METALS IN MARINE NEMERTEANS,
Liverpool Univ. (England). Dept. of Biology.
E. G. McEvoy.
Hydrobiologia HYDRB8, Vol. 156, p 135-143, January 4, 1988. 6 fig, 6 tab, 26 ref.

Descriptors: *Path of pollutants, *Bio, *Bioaccumulation, *Heavy metals, *Nemerteans, Marine environment, Metals, Lead, Cadmium, Zinc, Heteronemertea, Hoplonemertea, Llandudno, Wales, Scilly Isles, Invertebrates, Seasonal variation, Tissue analysis.

Accumulation of heavy metals by two species of eulittoral nemerteans, Lineus ruber (Heteronemertea) and Amphiporus lactifloreus (Hoplonemertea) varied seasonally and between species. Total body burdens of metals (expressed as microgram/gram dry weight) measured monthly over a 12-month period in Lineus ruber collected off the coast at Llandudno, Wales, were as follows: lead, 17.4-38.7; cadmium, 8.2-9.4; and zinc, 725-800. For Amphiporus lactifloreus at the same site, lead, 46.3-53.7; cadmium, 7.7-9.6; and zinc, 260-285. Mean total body burdens of metals (expressed as microgram/gram dry weight) in nemerteans collected off the Scilly Isles (two samplings) were as follows: Lineus ruber--lead, 0.1; cadmium, 0.35; and zinc, 80.5; Amphiporus lactifloreus--lead, 0.12; cadmium, 1.25; and zinc, 47. To differentiate between

metal absorbed on surface mucus and metal absorbed in body tissues, the organisms were immersed in iminodiacetic acid coupled to epoxy-activated Sepharose 6B (40-100 micron diameter). (Cassar-PTT)
W88-06909

NITRATE DEPLETION IN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM,
York Univ., Toronto (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W88-06919

BIODEGRADATION DATA EVALUATION FOR STRUCTURE/BIODEGRADABILITY RELATIONS,
Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.
P. H. Howard, A. E. Hueber, and R. S. Boethling.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 1, p, January 1987. 8 tab, 35 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Structure/biodegradability relations, *Biodegradation, *Biological treatment, *Organic compounds, *Organic wastes, Field tests, Grab samples, Quantitative analysis, Chemical properties, Chemical wastes.

Previous attempts at structure/biodegradability relations (SBRs) and available biodegradation data are reviewed and it is concluded that (1) not enough rate data on large numbers of chemicals are available to develop quantitative SBRs and (2) attempted qualitative SBRs have suffered from either poor documentation of the biodegradation evaluation or they have used limited biodegradation test data. Because of the poor reproducibility of biodegradation tests, a weight-of-evidence evaluation procedure is proposed. A system for collecting and evaluating biodegration data from screening tests, biological treatment simulations, grab sample tests and field studies is described and study-specific and summary biodegradability codes in combination with reliability codes are developed that can be used for structure/biodegradability relations. (Author's abstract)
W88-06921

REDUCTION IN BIOAVAILABILITY OF ORGANIC CONTAMINANTS TO THE AMPHIPOD PONTOPOREIA HOYI BY DISSOLVED ORGANIC MATTER OF SEDIMENT INTERSTITIAL WATERS,
Great Lakes Environmental Research Laboratory, Ann Arbor, MI 48104.
P. F. Landrum, S. R. Nihart, B. J. Eadie, and L. R. Herche.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 1, p 11-20, January 1987. 3 fig, 3 tab, 25 ref.

Descriptors: *Pesticides, *Heavy metals, *Organic matter, *Amphipods, *Lakes, *Polychlorinated biphenyls, *Bioavailability, Interstitial water, Organic compounds, Humic acids, Hydrocarbons, Adsorption, Great Lakes, Limnology.

Dissolved organic matter (DOM) in aquatic systems is known to reduce the bioavailability of heavy metals. Recent studies have shown similar reductions in bioavailability of organic contaminants. The mechanism for reduction, with Aldrich humics, was to reduce the freely dissolved, bioavailable, xenobiotic concentration by partitioning to DOM. This mechanism was also found to apply to organic contaminants in the presence of DOM from interstitial waters. A reverse-phase separation technique was used to measure the sorbed xenobiotic, and by difference from the total, the freely dissolved concentration of a contaminant permitting the calculation of a partition coefficient. Equilibrium partitioning of selected polycyclic aromatic hydrocarbon and polychlorinated biphenyl congeners to the DOM, in interstitial waters from several geographical sources, ranged over several orders of magnitude for a single compound. The reduction in bioavailability was measured by reduction in the conditional uptake rate constant for organic xenobiotics in the presence of DOM, for the amphipod Pontoporeia hoyi (the major benthic invertebrate in the Great Lakes). Reduction in the conditional uptake rate constant versus controls was used to calculate a biologically determined partition coefficient. The log of the reverse-phase partition coefficient was well correlated with the log of the biologically-determined partition coefficient over a range of three orders of magnitude in measured partition coefficient for individual compounds using DOM from different sources. (Author's abstract)
W88-06922

IN SITU VARIATIONS IN OYSTER MUTAGENICITY AND TISSUE CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
C. A. Pittinger, A. L. Buikema, and J. O. Falkinham.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 1, p 51-60, January 1987. 5 fig, 1 tab, 39 ref.

Descriptors: *Path of pollutants, *Mutagenicity, *Oysters, *Hydrocarbons, *Bioaccumulation, *Estuaries, *Water pollution effects, *Toxicity, *Salmonella, Gas chromatography, Dose-response studies, Bioassay, Chesapeake Bay, Comparison studies, Tissue analysis.

Variations in oyster mutagenicity were monitored in a series of in situ relocation experiments and compared with tissue concentrations of polycyclic aromatic hydrocarbons (PAHs). Oysters (Crassostrea virginica) were relocated among three rivers in the southern Chesapeake Bay and sampled over a 2-week exposure period. Extracts of oyster tissues were assayed for mutagenic activity by the Salmonella typhimurium microsomal test and analyzed for selected PAHs by gas chromatography. Oysters relocated to the polluted Elizabeth River (Norfolk, VA) from a pristine site (Ware River, VA) accumulated mutagenic activity and PAHs within 3 d following relocation. Mutagenicity increased over a 14-d period while tissue levels of most PAHs stabilized or declined after 3 d. Extracts of native oysters from the Elizabeth River exhibited comparable levels of mutagenic activity as 14-d relocated oysters. In elimination experiments, PAH levels and mutagenic activity of Elizabeth River oysters decreased following relocation to the Ware River and were not detected after 14 d. Regression analyses did not detect a significant association between slopes of mutagenicity dose-responses and tissue levels of PAHs. Marginal associations with numbers of Salmonella reverants per plate were detected in comparisons with sums of PAH tissue levels, and with tissue levels of benzofluoranthene. (Author's abstract)
W88-06925

PARAMETERIZATION OF PREDICTIVE FATE MODELS: A CASE STUDY,
Minnesota Mining and Mfg. Co., St. Paul. Environmental Lab.
K. H. Reinert, P. M. Rocchio, and J. H. Rodgers.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 2, p 99-104, February 1987. 4 fig, 3 tab, 18 ref.

Descriptors: *Mathematical models, *Parametric hydrology, *Herbicides, *Prediction, *Fate of Pollutants, *Sediments, Exposure Analysis Modeling System, Endothall, Reservoirs, Costs, Case studies, Parameterization, Aquatic environment, Organic pesticides.

Accurate prediction of chemical fate and persistence using general aquatic fate models requires model parameterization, i.e., the determination of site-specific environmental and chemical parameters for model input. The capability of one model, the Exposure Analysis Modeling System (EXAMS), to predict the fate of endothall, an aquatic herbicide, in a reservoir was compared using two different parameterization methods. The first method, limited parameterization, used only literature and limited field data. The second method, intensive parameterization, employed laboratory, experimental pool and field data. Differences of less than one order of magnitude were observed among the endothall fate predictions from EXAMS in this reservoir using either method. Predicted endothall aqueous half-lives were greater than the observed half-life by a factor of 5 to 9. Predicted endothall concentrations in sediment were consistently below the minimum detectable level (0.01 mg/kg) for endothall, whereas endothall concentrations were measured in reservoir sediments in the field. In this case, the results indicate that limited parameterization of EXAMS provides predictions of endothall persistence that are as accurate as those provided by intensive parameterization, thus saving time and reducing costs. Limited parameterization produced relatively accurate predictions in this study, possibly because only one fate process, biotransformation, was important. For chemicals affected by numerous fate processes, the errors associated with each fate process input could significantly affect the accuracy of predictions. (Author's abstract)
W88-06926

DETERMINATION OF UPTAKE RATE CONSTANTS FOR SIX ORGANOCHLORINES IN MIDGE LARVAE,
Ohio State Univ., Columbus. Dept. of Entomology.
T. W. Lohner, and W. J. Collins.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 2, p 137-146, February 1987. 2 fig, 3 tab, 30 ref.

Descriptors: *Bioassay, *Bioaccumulation, *Midges, *Absorption, *Population exposure, *Chlorinated hydrocarbons, *Organic compounds, *Uptake rates, Invertebrates, Organochlorines, Prediction, Costs, Pesticides, Regression analysis.

Various methods are used to measure the residue-forming potential of organic chemicals in aquatic organisms. The majority of these studies have been conducted with fish and rely on the determination of steady-state partitioning, a method that is expensive, both in terms of time and analytical cost. The midge (Chironomus riparius) is readily available, easily cultured and provides an alternative system with which to study chemical uptake. To evaluate this system, the uptake rate constants of six organochlorines were determined under nonequilibrium conditions, using the midge. Uptake rate constants were calculated from uptake data using a first-order kinetic expression. Significant correlations were found between the uptake constants of the six chlorinated hydrocarbons and their water solubility and octanol/water partition coefficient values. Multiplying the uptake constants by their molecular weight provided values that were highly correlated with log octanol/water partition coefficients (r squared = 0.93) and log aqueous solubility (r squared = 0.97) when analyzed by linear regression. Using the midge, uptake constants can be determined in a short time and may be used to make reliable predictions about the relative penetrating power of many chemicals in aquatic invertebrates. (Author's abstract)
W88-06930

FATE AND MOVEMENT OF AZAARENES AND THEIR ANAEROBIC BIOTRANSFORMATION PRODUCTS IN AN AQUIFER CONTAMINATED BY WOOD-TREATMENT CHEMICALS,
Geological Survey, Denver, CO.
W. E. Pereira, C. E. Rostad, D. M. Updegraff, and J. L. Bennett.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 3, p 163-176, March 1987. 6 fig, 2 tab, 28 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Azaarenes, *Pollutants, *Contamination, *Sand aquifers, *Biotransformation, *Groundwater pollution, *Infiltration rate, Pond sludges, Chemical degradation, Nutrients, On-site investigations, Partition coefficients.

Infiltration of wastes containing creosote and pentchlorophenol from surface impoundments at an abandoned wood-treatment facility near Pensacola, Florida, resulted in contamination of the underlying sand and gravel aquifer. Pond sludges and sediments near the source were contaminated with 2- to 5-ring azaarenes having n-octanol/water partition coefficient values of from 2.0 to 5.6. However, the ground water contained only azaarenes and their oxygenated and methylated derivatives having n-octanol/water partition coefficient values of less than 3.5. These compounds also were present in coal tar-contaminated ground water at site near St. Louis Park, Minnesota. Laboratory anaerobic degradation studies and on-site observations indicated that oxygenated azaarenes probably were biotransformation products of reactions mediated by indigenous microbial populations. Microbial N-methylation, C-methylation and O-methylation reactions are reported here for the first time. In the presence of nutrients and carbon sources such as acetate and propionate, all azaarenes studies were either partial or completely degraded. Evidence for the microbial degradation of azaarenes in ground water from anaerobic zones is presented. Oxygenated azaarenes were relatively more water-soluble, mobile and persistent in hydrogeologic environments. (Author's abstract)
W88-06932

MODELING THE IMPACT OF CONSERVATION TILLAGE PRACTICES ON PESTICIDE CONCENTRATIONS IN GROUND AND SURFACE WATERS,
AQUA TERRA Consultants, Mountain View, CA.
A. S. Donigian, and R. F. Carsel.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 241-250, April 1987. 2 fig, 8 tab, 34 ref.

Descriptors: *Cropland, *Cultivated land, *Fate of pollutants, *Pesticide residues, *Groundwater pollution, *Tillage, *Path of pollutants, Surface runoff, Pesticides, Organic carbon distribution coefficient, Carbofuran, Dicamba.

To analyze the environmental fate and migration of pesticides applied to croplands as they are affected by conservation tillage practices, pesticide models for leaching surface water and ground water were selected and an application method was developed. Fourteen different pesticides applied to corn and soybeans were analyzed to determine probable concentrations in ground water and surface water under conventional tillage, reduced tillage and no tillage practices; the Lake Erie Basin was the study site. Surface runoff loadings and concentrations decreased under the conservation tillage scenarios, but ground water loadings and concentrations increased as a result of the decreased runoff and increased ground water recharge. Reduced tillage decreased surface runoff loadings and concentrations increased as a result of the decreased runoff and increased ground water recharge. Reduced tillage decreased surface runoff loads and concentrations by about 50% as compared with conventional tillage, and no tillage resulted in another 20% reduction. The pesticides with the highest surface runoff loads and concentrations were those with organic carbon distribution coefficients values generally less than 200 ml/g and root zone half-lives greater than 40 d. For ground water, only four pesticides demonstrated mean annual loadings high enough to require estimation of resulting ground water concentrations. These four compounds also had the highest surface loadings and are characterized by organic carbon distribution coefficients values of 100 ml/g or less and root zone half-lives of 35 d or longer. Ground water concentrations for all four compounds were low,, with carbofuran showing the highest concentrations (approaching 1.0 ppb). Next was dicamba, but its concentrations were four to five orders of magnitude less. Sensitivity analyses for carbofuran indicated that the concentrations could be at least one order of magnitude higher, depending on assumptions related to decay rate, hydraulic conductivity and other hydrogeologic parameters. (Author's abstract)
W88-06936

COMPARISON OF MODELS THAT DESCRIBE THE TRANSPORT OF ORGANIC COMPOUNDS IN MACROPOROUS SOIL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. R. Southworth, K. W. Watson, and J. L. Keller.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 251-257, April 1987. 5 fig, 1 tab, 15 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Model studies, *Hydraulic models, *Organic compounds, *Soil columns, *Tracers, *Pervious soils, *Pores, *Advection, *Elution, Advection-dispersion models, Chlorobenzenes, Mathematical models, Macropores.

Experiments were conducted on an intact soil column to test the suitability of several transport codes in describing the movement of reactive organic compounds through soil containing preferred flow pathways (macropores). The equilibrium-based advection-dispersion model and the nonequilibrium two-region/two-site model were used to describe the elution of a nonretarded tracer ((14C)methanol) and two retarded tracers (trichlorobenzene and tetrachlorobenzene). The advection-dispersion model proved adequate in describing the movement of the nonreactive tracer but it failed to describe the elution of the hydrophobic organics. The organic tracers required the nonequilibrium model to account for their apparent rapid movement. The two-site model, when calibrated to the trichlorobenzene breakthrough data, successfully predicted the elution of tetrachlorobenzene. (Author's abstract)
W88-06937

PCB AVAILABILITY ASSESSMENT OF RIVER DREDGING USING CAGED CLAMS AND FISH,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5G.
W88-06938

ESTIMATING SAMPLE REQUIREMENTS FOR FIELD EVALUATIONS OF PESTICIDE LEACHING,
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
For primary bibliographic entry see Field 7A.
W88-06943

DIRECT AND INDIRECT PHOTOLYSIS OF WATER-SOLUBLE AZODYES: KINETIC MEASUREMENTS AND STRUCTURE-ACTIVITY RELATIONSHIPS,
SRI International, Menlo Park, CA. Chemistry Lab.
W. R. Haag, and T. Mill.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 5, p 359-369, May 1987. 4 fig, 6 tab, 28 ref. EPA Contract 68-02-3968, Versar, Inc. subcontract 867.1.

Descriptors: *Fate of pollutants, *Dyes, *Water properties, *Chemical properties, *Photolysis, *Azodyes, Photoactivation, Chemical reactions, Ion exchange, Organic carbon, Singlet oxygen, Structure-activity relationships.

Azodyes dissolved in water containing humic acid (total organic carbon = 5 mg/L) and irradiated with a xenon lamp were transformed primarily by an indirect photoprocess involving singlet oxygen and/or oxyradicals. Dissociation of the phenolic/naphtholic OH groups of the dyes was the dominant factor in increasing indirect photolysis rates. Simplified structure-activity relationships were developed based on pKa prediction methods and on the observation that the reactivities of the dissociated forms of all the dyes are nearly the same. Products of indirect photolysis could not be identified, but loss of color suggests cleavage of the azo linkage in nearly all cases. Aromatic amines are not likely to be formed. (Author's abstract)
W88-06944

PRODUCTS OF HEXACHLOROCYCLOPENTADIENE (C-56) IN AQUEOUS SOLUTION,
Geochemistry Section, Illinois State Geological Survey, Champaign, Illinois 61820.
S. J. Chou, R. A. Griffin, M. M. Chou, and R. A. Larson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 5, p 371-376, May 1987. 4 fig, 1 tab, 18 ref. EPA Grant R-806335-01-1.

Descriptors: *Hexachloroyclopentadiene, *Organic compounds, *Fate of pollutatns, *Degradation, *Photodegradation, *Degradation products, *Photolysis, Chemical properties, Chemical reactions, Isomers, Dissociation, Water properties.

The photodegradation and degradation products of hexachlorocyclopentadiene (C-56) in aqueous solutions were studied in the laboratory. In each case, the half-life of C-56 was less than 4 min when exposed to sunlight. At least eight degradation products were positively or tentatively identified: 2,3,4,4,5-pentachloro-2-cyclopentenone, hexachloro-2-cyclopentenone and hexachloro-3-cyclopentenone were the primary photodegradation products, and pentachloro-cis-2,4-pentadienoic acid, Z- and E-pentachlorobutadiene and tetrachlorobutyne were the secondary degradation products. Dissociation of the primary photolysis products may proceed through corresponding pentadienoic acids to form smaller molecular weight compound such as pentachlorobutadiene isomers and tetrachlorobutyne. In addition, dimerization of 2,3,4,4,5-pentachloro-2-cyclopentenone to form higher molecular weight compounds such as hexachloroindenone may present a minor route of degradation. The results also indicate that C-56 is highly photoreactive and suggest a possible pathway for the compound's transformation in the environment when exposed to light. (Author's abstract)
W88-06945

LABORATORY STUDIES ON MECHANISMS FOR THE DEGRADATION OF ALDICARB, ALDICARB SULFOXIDE AND ALDICARB SULFONE,
Wisconsin Univ., Madison. Dept. of Chemical Engineering.
E. N. Lightfoot, P. S. Thorne, R. L. Jones, J. L. Hansen, and R. R. Romine.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 5, p 377-394, May 1987. 4 fig, 6 tab, 22 ref.

Descriptors: *Biodegradation, *Insecticides, *Fate of pollutants, *Aldicarbs, *Pesticides, *Chemical degradation, *Metabolites, *Topsoil, *Soil columns, Soil chemistry, Soil Horizons, Saturation zone, Saturated soils, Oxidation, Oxides, Temperature, Hydrogen ion concentration, Hydrolysis.

Experiments were performed in order to better define the degradation mechanisms and kinetics for aldicarb and its two metabolites, aldicarb sulfoxide and aldicarb sulfone. The mechanisms studies were oxidation in surface soil and saturated zone soil samples, degradation in saturated zone soil samples and distilled water hydrolysis. The studies showed that soil is an important mechanistic factor, probably because surface catalysis occurs. Temperature and pH are important factors in determining degradation rates. The experiments seem to indicate that microbial oxidation is an important degradation mechanism in the surface soil, but the breakdown of aldicarb residues to noncarbamates is largely the result of chemical hydrolysis. The reduction of aldicarb sulfoxide to aldicarb was observed in the presence of limestone but only after an incubation period of two to six months. No reduction of aldicarb sulfone to aldicarb sulfoxide was observed in these experiments. The complexity of degradation is such that laboratory studies can augment but not replace well-designed experiments conducted under actual field conditions. (Author's abstract)
W88-06946

CASE AGAINST MERCURY (II) METHYLATION BY AQUATIC ENVIRONMENTAL METHYLSILOXANES,

Health and Environmental Sciences Department, Dow Corning Corporation, Midland, Michigan 48686-0994.
C. L. Frye, and H. Chu.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 2, p 95-98, February 1988. 15 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Methylation, *Mercury, *Chemical properties, Aquatic environment, Water pollution, Chemical reactions, Sediments.

The literature relating to the methylation of mercury salts by methylsilicon species was reviewed and assessed from the standpoint of potential ecological significance. The probability of such reactions occurring under any likely aquatic environmental conditions is shown to be extremely low. This conclusion is strongly reinforced by experiments in which water-soluble analogs of the methylsiloxanes (materials reportedly present as traces in some aquatic sediments) were shown to be completely unaffected by mercuric chloride at ambient laboratory temperatures. Few additional studies with other mercury salts (e.g. acetate or nitrate) or higher temperatures were performed because of their irrelevance to any likely aquatic environmental situation. (Author's abstract)
W88-06952

BIODEGRADATION OF THREE AZAARENE CONGENERS IN RIVER WATER,
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
R. A. Cassidy, W. J. Birge, and J. A. Black.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 2, p 99-105, February 1988. 6 fig, 1 tab, 15 ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Biodegradation, *Azaarenes, *Chemical properties, Lethal limit, Substrates, Streams, Pyridine, Quinoline, Kinetics, Acridine, Toxicity.

The biodegradability of three structurally related azaarenes (pyridine, quinoline, and acridine) at various concentrations (which gave 0 to 100% lethality to embryo-larval stages of an indigenous frog species) was determined using a river water die-away test and water collected from the Green River (Newton, KY). HPLC analyses of the amended river water during the 6- and 11-d study revealed rapid removal of pyridine and quinoline at the lower substrate concentrations; however, no change in the acridine concentrations was detected during the 11-d study. Except for the lowest quinoline concentration, the turnover times and latent periods for pyridine and quinoline increased with higher initial concentrations, but the kinetics of microbial oxidation were constant at all but the highest concentrations. The adaptation of previously exposed river flora was determined by re-spiking degraded waters. When the flora were reexposed to the substrates there was no latent period and the kinetics were superimposable. By tracking the metabolites of quinoline, sequential oxidation of the parent compound to more polar species was demonstrated. It was determined by co-culturing quinoline and acridine that acridine nondegradability was not due to any inhibitory effect that acridine may have on the river flora. (Author's abstract)
W88-06953

PREDICTION OF CONSUMER PRODUCT CHEMICAL CONCENTRATIONS AS A FUNCTION OF PUBLICLY OWNED TREATMENT WORKS TREATMENT TYPE AND RIVERINE DILUTION,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
R. A. Rapaport.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 2, p 107-115, February 1988. 5 fig, 4 tab, 17 ref.

Descriptors: *Water pollution sources, *Outfall, *Wastewater treatment, *Wastewater outfall, *Chemical composition, *Effluent seepage, *Mathematical models, Activated sludge, Trickling filters, Surface waters, Stream discharge, Water pollution, Wastewater disposal, Model studies.

In the United States, effluent from publicly owned treatment works (POTW) becomes diluted in surface waters. These initial concentrations of chemicals in rivers below the effluent outfalls are used as conservative estimates of downstream concentrations. Using computerized U.S. Environmental Protection Agency databases, which include POTW flow rates and receiving water stream flows, dilution factors were determined for activated sludge, trickling filter, and primary treatments as a function of total U.S. POTW discharge and the total number of POTW. Curves were constructed and mathematical functions fitted for POTW flow and number versus dilution factor for each of the treatment types. Using a computer program in which these curves are applied, the fraction of total POTW flow discharged to U.S. rivers and streams that will have a concentration greater than any specified value (e.g. water quality criteria) can be predicted. This procedure will be useful in safety assessments of chemicals discharged to natural waters as components of POTW effluent. (Author's abstract)
W88-06954

EFFECTS OF DIMILIN(RT) ON FRESHWATER LITTER DECOMPOSITION,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
For primary bibliographic entry see Field 5C.
W88-06955

FATE OF 1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN IN AN OUTDOOR AQUATIC SYSTEM,
R. L. Corbet, G. R. Barrie Webster, and D. C. G. Muir.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 2, p 167-180, February 1988. 7 fig, 2 tab, 31 ref.

Descriptors: *Duckweed, *Fate of pollutants, *Dioxins, *Organic compounds, *Botiom sediments, *Ponds, Air-water interface, Chemical properties, Vegetation, Chemical degradation, Aquatic vegetation.

Three outdoor pools (5.5 cu m) were treated with (C14)1,3,6,8-tetrachloridibenzo-p-dioxin (1,3,6,8-T4CDD) at concentrations of 98, 245 and 980 ng/L, and the movements and accumulation of the compound were monitored in air, water, sediment and vegetation over a 426-d period. The concentrations of 1,3,6,8-T4CDD in the air above the treated pools ranged from 8.4 to 18.8 ng/cu m during the first day after treatment. Total C14 concentration in the water column declined rapidly, with more than 90% lost from the water phase within 96 h (t sub 1/2 = 14.0 to 28.5 h). The sediments were the major reservoir for the compound, accounting for 34 to 80% of the added compound at 34 d and 5 to 14% at 426 d. Total (C14)T4CDD concentrations in the sediments increased at 90 d, in part because of the end-of-season deposition of rooted vegetation. 1,3,6,8-T4CDD degraded in natural water in Pyrex flasks at similar rates in sterile and nonsterile waters (t sub 1/2 = 6.3 to 8.0 d) in sunlight, but not under darkened conditions. A single, polar photodegradation product (retention time 0.82 relative to 1,3,6,8-T4CDD) was detected by HPLC, and 20% of the C14 was unextractable within 10 d. Similar degradation products were noted in the water and sediments (90 and 426 d). In duckweed (Lemna sp.) and (Potamogeton sp.), concentration factors for 1,3,6,8T4CDD ranged from 25,000 to 34,000 and from 27,000 to 200,000 respectively. At 426 d posttreatment, 5 to 8% of the applied 1,3,6,8-T4CDD cound be accounted for in all aquatic compartments, with an additional 4 to 6% of C14 present as unidentified polar products and unextractable residue. (Author's abstract)
W88-06957

FATE OF DYES IN AQUATIC SYSTEMS: I. SOLUBILITY AND PARTITIONING OF SOME HYDROPHOBIC DYES AND RELATED COMPOUNDS,
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
G. L. Baughman, and T. A. Perenich.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 3, p 183-199, March 1988. 6 tab, 45 ref. EPA Grant No. CR812638.

Descriptors: *Dyes, *Dye dispersion, *Solubility, *Water pollution effects, *Chemical properties, Bottom sediments, Henry's law, Biological magnification, Computers.

Solubilities and vapor pressures from the literature were combined with calculated octanol/water partition coefficients, K sub ow, to assess the expected environmental behavior of about 50 dyes. Most of the older disperse dyes (those that have been in use for decades) have solubilities on the order of 10 to the minus 7th power to 10 to the minus 6th power M. This solubility suggests the potential for a 30- to 150-fold concentration enhancement in sediments and bioconcentration of about 1,000 times in the absence of metabolism. The data also indicate that solubilities computed from K sub ow for disperse dyes is 10 to 100 times smaller than reported for most other compounds. Henry's law constants calculated from solubility and vapor pressure show that the disperse and vat dyes will be entirely gas-phase-controlled in their rate of volatilization from water and that this process will be extremely slow. No definitive conclusions can be drawn about the behavior of more recently developed disperse dyes. The available physical constants are compiled along with structures, Color Index number, CAS number and names for 80 compounds. (Author's abstract)
W88-06958

DIETARY ACCUMULATION OF FOUR CHLORINATED DIOXIN CONGENERS BY RAINBOW TROUT AND FATHEAD MINNOWS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and A. L. Yarechewski.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 3, p 227-236, March 1988. 3 fig, 3 tab, 39 ref.

Descriptors: *Organic compounds, *Bioaccumulation, *Metabolism, *Minnows, *Assimilative capacity, *Trout, *Path of pollutants, *Chlorinated hydrocarbons, Chemical properties, Toxicity, Food chains, Great Lakes.

Accumulation of four C14-labeled polychlorinated dibenzo-p-dioxins (PCDDs), 1,2,3,7-T4CDD, 1,2,3,4,7-P5CDD, 1,2,3,4,7,8-H6CDD, and 1,2,3,4,6,7,8-H7CDD, by juvenile rainbow trout (Salmo gairdneri) and fathead minnows (Pimephales promelas) was studied by feeding the fish treated food for 30 d followed by a 30- to 75-d depuration period. Assimilation efficiencies (based on total C14) of the isomers were low, ranging from 13% for H7CDD to 37% for H6CDD in trout, as compared with 64% for 4,4'-DDT under the same conditions. Bioaccumulation factors, assimilation efficiencies and elimination rate constants for each PCDD congener were lower in fathead minnows than in rainbow trout. Half-lives for total C14 ranged from 9 to 13 d for T4CDD and P5CDD in trout and minnows, respectively, and from 46 to 112 d for H6CDD and H7CDD in the same fish. Toluene-extractable radioactivity for T4CDD and P5CDD was < 30% during the clearance phase, indicating extensive transformation to polar products in both species. A four-compartment model was used to estimate the accumulation of H6CDD and H7CDD in Great Lakes food chains (from detritus/phytoplankton to lake trout). The model predicted decreasing concentrations of the PCDDs at higher trophic levels, with accumulation primarily from food, assuming freely dissolved water concentrations of less than 2 x 10 to the minus 5th power ng/L. (Author's abstract)
W88-06961

MANAGEMENT STRATEGY FOR ACIDIC DEPOSITION IN WESTERN AND NORTHERN CANADA,

Alberta Dept. of Environment, Edmonton.
H. S. Sandhu, and R. G. Wilson.
Environmental Management EMNGDC, Vol. 11, No. 5, p 637-640, September 1987. 2 fig, 1 tab, 13 ref.

Descriptors: *Acid rain, *Canada, *Sulfites, *Management planning, *Water pollution sources, *Air pollution, *Governmental interrelations, Administrative decisions, Policy making, Monitoring.

The governments of British Columbia, Alberta, Saskatchewan, Manitoba, Northwest Territories, and Canada held joint consultations in 1980 to review the available information on acid rain from Western and Northern Canada. It was concluded that acid rain might become a problem in the future and, hence, a research, monitoring, and management strategy for acidic deposition was needed. The acid deposition management strategy adopted by the government has four basic elements: (1) determine the sensitivity of the western and northern Canadian environment to acid deposition; (2) establish target loadings; (3) monitor to ensure compliance with the targets; and (4) establish emission management plans. Sensitivity maps to acid deposition have identified major areas that are highly sensitive; 47% of the 520 lakes sampled in Saskatchewan and 20% of the 720 lakes sampled in British Columbia were classified as highly sensitive. There is no evidence of acidification. The process of establishing a suitable target loading has been started. Precipitation chemistry is being monitored at 62 sites in the region. Wet sulfate deposition at most locations is < 10 kg/ha/yr. Transport and deposition models suitable for the region are being developed. (Freemann-PTT)
W88-06972

CAPACITY OF AQUATIC BACTERIA TO ACT AS RECIPIENTS OF PLASMID DNA,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
F. J. Genthner, P. Chatterjee, T. Barkay, and A. W. Bourquin.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 115-117, January 1988. 2 tab, 12 ref.

Descriptors: *Environmental effects, *Genetic engineering, *Water pollution sources, *Path of pollutants, *Bacterial physiology, *Plasmid transfer, *Pseudomonas, Culturing techniques, Bacteria.

A total of 68 gram-negative freshwater bacterial isolates were screened for their ability to receive and express plasmids from Pseudomonas aeruginosa donors. The plate mating technique identified 26 of the isolates as recipient active for the self-transmissible wide-host-range plasmid R68; 10 were recipient active by R68 mobilization for the wide-host-range plasmid cloning vector R1162. Frequencies of transfer were compared by using three conjugal transfer procedures: broth, plate, and filter mating. For every recipient tested, a solid environment was superior to a liquid environment for transfer. The broth mating technique failed to demonstrate R68 transfer in 63% of the recipient-active isolates. Filter mating, in general, yielded the highest transfer frequencies. The more-rapid plate mating procedure, however, was just as sensitive for testing the capacity of natural isolates to participate in conjugal plasmid transfer. (Author's abstract)
W88-07000

POLIOVIRUS RETENTION IN SOIL COLUMNS AFTER APPLICATION OF CHEMICAL- AND POLYELECTROLYTE-CONDITIONED DEWATERED SLUDGES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
O. C. Pancorbo, G. Bitton, S. R. Farrah, G. E. Gifford, and A. R. Overman.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 118-123, January 1988. 5 tab, 26 ref. EPA Grant R804570.

Descriptors: *Sludge disposal, *Path of pollutants, *Groundwater pollution, *Poliovirus, *Soil columns, *Leachates, Flocculation, Aerobic digestion, Inactivation, Wastewater treatment.

The transport of poliovirus type 1 (strain LSc) was studied in Red Bay sandy loam columns that were treated with chemical- or polyelectrolyte-conditioned dewatered sludges and then leached with natural rainwater under saturated flow conditions. Poliovirus was concentrated in the alum and ferric chloride sludges that were produced following the flocculation of virus-seeded raw sewage. Virtually complete inactivation of the virus was observed following the flocculation of raw sewage or the stabilization of alum and ferric chloride sludges with lime at pH 11.5. Poliovirus was also concentrated in polyelectrolyte-conditioned dewatered sludge that was produced from virus-seeded, anaerobically digested sludge. Despite the saturated flow conditions for a sustained period, no viruses were detected in the leachates of the soil columns that were treated with these chemical and chemically treated sludges. Since the viruses were mostly associated with the solids in these sludge samples, it is believed that they were immobilized along with the sludge solids in the top portion of the soil columns. (Author's abstract)
W88-07001

INFLUENCE OF INORGANIC AND ORGANIC NUTRIENTS ON AEROBIC BIODEGRADATION AND ON THE ADAPTATION RESPONSE OF SUBSURFACE MICROBIAL COMMUNITIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. M. Swindoll, C. M. Aelion, and F. K. Pfaender.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 212-217, January 1988. 6 fig, 1 tab, 17 ref. EPA Cooperative Agreement CR811828.

Descriptors: *Biodegradation, *Fate of pollutants, *Path of pollutants, *Groundwater pollution, *Aquifers, *Mineralization, *Limiting nutrients, *Microbial degradation, Microbiological studies, Metabolites, Organic compounds, Biodegradation.

The influence of inorganic and organic amendments on the mineralization of ethylene dibromide, p-nitrophenol, phenol, and toluene was examined in subsurface soil samples from a pristine aquifer near Lula, Okla. The responses indicate that the metabolic abilities and nutrient requirements of groundwater microorganisms vary substantially within an aquifer. In some samples, additions of inorganic nutrients resulted in a more rapid adaptation to the test substrate and a higher rate of metabolism, indicating that metabolism may have been limited by these nutrients. In other samples from the same aquifer layer, inorganic amendments had little or no influence on mineralization. In general, the addition of multiple inorganic nutrients resulted in a greater enhancement of degradation than did the addition of single substances. Additions of alternate carbon sources, such as glucose or amino acids, inhibited the mineralization of the xenobiotic substrates. This inhibition appears to be the result of the preferential utilization of the more easily degradable carbon amendments. (Author's abstract)
W88-07003

REDUCTIVE DECHLORINATION OF HEXACHLOROBENZENE TO TRI- AND DICHLOROBENZENES IN ANAEROBIC SEWAGE SLUDGE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5D.
W88-07005

VIRUSES IN SEWAGE WATERS DURING AND AFTER A POLIOMYELITIS OUTBREAK AND SUBSEQUENT NATIONWIDE ORAL POLIOVIRUS VACCINATION CAMPAIGN IN FINLAND,
Enterovirus Lab., Dept. of Virology, National Public Health Inst., Helsinki, Finland.
T. Poyry, M. Stenvik, and T. Hovi.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 371-374, February 1988. 1 fig, 5 tab, 9 ref.

Descriptors: *Public health, *Path of pollutants, *Water pollution sources, *Poliovirus, *Finland, *Epidemiology, *Wastewater analysis, Public health, Wastewater, Enteroviruses.

During an outbreak of paralytic poliomyelitis in Finland in 1984 and 1985 the widespread circulation of the causative wild-type serotype 3 poliovirus in the population was documented by demonstrating the virus in sewage water specimens in 13 different locations in the greater Helsinki district and in 13 other cities or towns all over the country. After the nationwide campaign with oral poliovirus vaccine in 1985, poliovirus serotypes 2 and 3 were readily isolated from sewage waters for up to 2 months, whereas type 1 poliovirus seemed to disappear from the sewage more rapidly. All of these isolates were temperature sensitive and therefore most likely vaccine related. The efficacy of the vaccination campaign in regard to elimination of the epidemic type 3 strain was evaluated by a follow-up study on viruses in sewage waters continued for 12 months through the subsequent expected season of poliomyelitis. Several types of enteroviruses, including five vaccine-related poliovirus strains, were identified in the 72 virus-positive specimens out of 93 studied. No wild-type polioviruses were found, indicating the success of the campaign. (Author's abstract)
W88-07007

ANIMAL VIRUSES, COLIPHAGES, AND BACTERIA IN AEROSOLS AND WASTEWATER AT A SPRAY IRRIGATION SITE,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
K. P. Brenner, P. V. Scarpino, and C. S. Clark.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 409-415, February 1988. 2 fig, 3 tab, 40 ref.

Descriptors: *Impaired water use, *Analytical methods, *Viruses, *Aerosols, *Coliphages, *Bacteria, *Irrigation water, Bioassay, Aeration.

Aerosol samples collected at the Muskegon County Wastewater Management System Number 1 spray irrigation site in Michigan by using the Army prototype XM2 Biological Sampler/Collector were examined for the presence of animal viruses, coliphages, and bacteria. Air samples, collected in Earle lactalbumen hydrolysate, and wastewater samples were filtered through a 0.45- and 1.2-micron membrane filter sandwich, pretreated with 10% beef xtract (pH 7.0), and assayed for animal viruses by the plaque method on Buffalo green monkey kidney cells. Untreated air and wastewater samples were assayed for coliphages by the soft agar overlay method with three Escherichia coli hosts (ATCC 13706, 15597, and 11303) and for bacteria by the heterotrophic plate count method. Filtered air samples were assayed for coliphages by the most-probable-number method method with the same three hosts. Although no animal viruses were detected in the aerosol samples, coliphages and bacteria were recovered. E. coli ATCC 13706 coliphage were recovered more often and in greater numbers than either of the other two types of coliphages. Concentrations of animal viruses,coliphages, and bacteria detected in the raw influent decreased as the wastewater was aerated and stored in the lagoons. No animal viruses were detected in the wastewater at the pump station just before distribution to the spray irrigation rigs. The most-probable-number method was more sensitive and consistent than the overlay procedure in detecting low levels of coliphages in air samples. (Author's abstract)
W88-07008

PREDICTION OF SUBSTRATE REMOVAL RATES OF ATTACHED MICROORGANISMS AND OF RELATIVE CONTRIBUTIONS OF ATTACHED AND SUSPENDED COMMUNITIES AT FIELD SITES,
Environmental Research Lab., Athens, GA.
D. L. Lewis, and D. K. Gattie.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 434-440, February 1988. 3 fig, 1 tab, 21 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Biodegradation, *Wetlands, *Herbicides, *Model studies, *Microbial degradation, Microorganisms, Mathematical studies, Organic compounds.

A mathematical model uses a direct proportionality relationship between bulk water velocities and field-determined second-order microbial transformation rate coefficients along with the rate coefficient of a benchmark chemical to estimate the substrate removal rates of rapidly degraded chemicals by attached organisms in shallow (<1 m deep) aquatic ecosystems. Data from 31 field experiments involving the addition of 2,4-dichlorophenoxyacetic acid methyl ester (2,4-DME) in nine field areas were used to determine a field-derived second-order rate coefficient for microbial transformation of the ester. By using 2,4-DME as a benchmark chemical, the model was used to predict microbial transformation rates of the butoxyethyl ester of 2,4-dichlorophenoxyacetic acid (2,4-DBE) at five other field sites. The predicted half-lives of 2,4-DBE varied 1,500-fold and were within about a threefold range or less of the measured half-lives. Under conditions of mass transport limitation, the contributions of attached microorganisms relative to total microbial activities at various field sites were related to the ratio of water velocity, U, and depth, D, showing that historical definitions of ecosystems according to flow and depth characteristics are also valid for describing the process-related structure of ecosystems. An equation was developed for predicting the relative contributions of attached and suspended communities with values of U and D for lotic and lentic ecosystems and suspended microorganisms were expected to be insignificant in shallow lotic systems for the same process carried out by both populations. Neglecting epiphytic microorganisms, both suspended and attached organisms were expected to be significant in wetlands. (Author's abstract)
W88-07009

TEMPORAL AND GEOGRAPHICAL DISTRIBUTIONS OF EPILITHIC SODIUM DODECYL SULFATE-DEGRADING BACTERIA IN A POLLUTED SOUTH WALES RIVER,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
D. J. Anderson, M. J. Day, N. J. Russell, and G. F. White.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 555-560, February 1988. 4 fig, 2 tab, 22 ref.

Descriptors: *Detergents, *Fate of pollutants, *Surfactants, *Rivers, *Biodegradation, *Microbial degradation, Microorganisms, Seasonal variation, Biological oxygen demand, Bacteria, Temporal distribution, Water pollution effects, *Spatial distribution, Enzymes.

Epilithic bacteria were isolated nonselectively from riverbed stones and examined by gel zymography for their ability to produce alkylsulfatase (AS) enzymes and thus to metabolize alkyl sulfate surfactants such as sodium dodecyl sulfate. The percentages of AS+ isolates from stone epilithon at five sites from the source to the river mouth were measured on five sampling days spread over 1 year. The results showed that (1) the prevalence of epilithic AS+ strains (as a percentage of all isolates) was much higher at polluted sites than at the source; (2) when averaged over the whole river, percentages of AS+ strains were significantly higher at the end of summer compared with either the preceding or the following winter; (3) analysis of site-sampling time interactions indicated that water quality factors (e.g., biochemical oxygen demand and dissolved oxygen concentration) rather than climatic factors determined the distributions of epilithic AS+ isolates; (4) constitutive strains were the most prevalent (7.2% of all isolates), with smaller numbers of isolates with inducible (4.5%) and repressible (1.7%) enzymes. (Author's abstract)
W88-07014

TRICHLOROETHYLENE METABOLISM BY MICROORGANISMS THAT DEGRADE AROMATIC COMPOUNDS,
Technology Applications, Inc., Gulf Breeze, FL.
M. J. K. Nelson, S. O. Montgomery, and P. H. Pritchard.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 604-606, February 1988. 3 tab, 13 ref.

Descriptors: *Fate of pollutants, *Trichloroethylene, *Biodegradation, *Microbial degradation, *Chlorinated hydrocarbons, *Aromatic compounds, *Pseudomonas, Microbiological studies, Metabolites, Organic compounds, Enzymes, Degradation.

Trichloroethylene (TCE) was metabolized by the natural microflora of three different environmental water samples (estuarine, river, and graoudwater from the Pensacola, Florida, areae) when stimulated by the addition of either toluene or phenol. Two different strains of Pseudomonas putida that degrade toluene by a pathway containing a toluene dioxygenase also metabolized TCE. A mutant of one of these strains lacking an active toluene dioxygenase could not degrade TCE, but spontaneous revertants for toluene degradation also regained TCE-degradative ability. The results implicate toluene dioxygenase in TCE metabolism. (Alexander-PTT)
W88-07016

MICROBIAL DECOMPOSITION IN AQUATIC ENVIRONMENTS: COMBINED PROCESS OF EXTRACELLULAR ENZYME ACTIVITY AND SUBSTRATE UPTAKE,
Institut fur Meereskunde, Dusternbrooker Weg 20, D-2300 Kiel, Federal Republic of Germany.
H.-G. Hoppe, S.-J. Kim, and K. Gocke.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 784-790, March 1988. 2 fig, 3 tab, 25 ref.

Descriptors: *Fate of pollutants, *Amino acids, *Model studies, *Biodegradation, *Microbial degradation, *Isotope studies, *Peptides, *Bioaccumulation, Radioactive tracers, Mathematical studies, Turnover rate, Kill Fjord, Decomposition.

A model for the coupling between extracellular-enzyme activity and substrate uptake by bacterial populations in natural waters was defined. The balance between uptake of leucine and extracellular hydrolytic production of leucine from a peptide model substrate was investigated in a combined fluorescence-radiotracer experiment with (3H)leucine as a marker for the leucine pool and L-leucine-4 methyl-7-coumarinylamide (Leu-MCA) as a marker for the pool of dissolved peptide substrates. At low concentrations of the model substrate, the input and uptake processes of leucine are nearly balanced, whereas at high concentrations of the model substrate much more leucine is liberated than taken up. In addition, water samples from one polluted and one less polluted station in the Kiel Fjord were investigated for their extracellular enzymatic and uptake properties in an annual cycle. Turnover rates of leucine (T sub r, percent per hour) and hydrolysis rates of Leu-MCA (H sub r, percent per hour), as well as the quotient T sub r/H sub r, reflect the impact of environmental conditions on decomposition processes at both sampling sites. The quotient T sub r/H sub r is interpreted as an indirect measurement of the pool size ratio (polymers/monomers), which may serve as an index of hydrolysis-uptake coupling in bacterial utilization of dissolved protein. Calculated on an annual average basis, turnover rates are nine times higher than hydrolysis rates at the polluted station and five times higher at the less polluted station. From the described model, this would mean that the relative fraction of polymers within the total dissolved organic carbon pool (with regard to the substrate combination dissolved protein-leucine) is about twice that at the polluted than at the less polluted station. (Author's abstract)
W88-07023

BACTERIAL LEACHING OF METALS FROM DIGESTED SEWAGE SLUDGE,
Universite du Quebec, INRS-Eau, C. P. 7500, 2700 rue Einstein, Sainte-Foy, (Quebec), Canada G1V4C7.
For primary bibliographic entry see Field 5D.
W88-07062

AGE AND GROWTH, REPRODUCTIVE CYCLE, AND HISTOCHEMICAL TESTS FOR HEAVY METALS IN HARD CLAMS, MERCENARIA MERCENARIA, FROM RARITAN BAY, 1974-75,
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
For primary bibliographic entry see Field 5C.
W88-07064

USEFULNESS OF COMPREHENSIVE FEASIBILITY STUDIES IN ENVIRONMENTAL EPIDEMIOLOGY INVESTIGATIONS: A CASE STUDY IN MINNESOTA,
Section of Chronic Disease and Environmental Epidemiology, Minnesota Dept. of Health.
For primary bibliographic entry see Field 5C.
W88-07066

PATHOGENIC MICRO-ORGANISMS AND HELMINTHS IN SEWAGE PRODUCTS, ARABIAN GULF, COUNTRY OF BAHRAIN,
Biological Sciences, Univ. of Wisconsin-Parkside, Box No. 2000, Kenosha, WI 53151-2000.
For primary bibliographic entry see Field 5D.
W88-07067

COMMON-SOURCE COMMUNITY AND INDUSTRIAL EXPOSURE TO TRICHLOROETHYLENE,
Div. of Environmental and Occupational Medicine, Mt. Sinai School of Medicine, 1 Gustave L. Levy Place, New York, NY.
P. J. Landrigan, G. F. Stein, J. R. Kominsky, R. L. Ruhe, and A. S. Watanabe.
Archives of Environmental Health AEHLAU, Vol. 42, No. 6, p 327-332, November/December 1987. 2 fig, 5 tab, 25 ref.

Descriptors: *Path of pollutants, *Path of pollutants, *Population exposure, *Chlorinated hydrocarbons, *Trichlorethylene, *Toxicity, *Occupational exposure, Water pollution effects, Water pollution sources, Metabolites, Spatial distribution, Organic compounds, Public health.

In July 1979, 1,900 gallons of trichloroethylene (TCE) were released into ground and surface water from a pipe manufacturing plant in Montgomery County, Pennsylvania. Community and occupational exposure to TCE, was conducted environmental and medical surveys. In well water samples obtained in August 1979 within 1 km of the factory, TCE concentrations ranged to 183,000 parts per billion (ppb); EPA's proposed guideline for TCE in drinking water is 5 ppb. Levels of TCE declined with distance from the plant, mean time-weighted occupational exposure to TCE of degreaser operators was 205 mg/cu m; the recommended time-weighted exposure limit is 135 mg/cu m. Mean short-term exposure was 1,084 mg/cu m; the recommended short-term limit is 535 mg/cu m. Seven of 9 exposed workers reported drowsiness, dizziness, or mental confusion. In exposed workers, mean urinary excretion of TCE metabolites rose from 298 micrograms/L pre-shift to 480 micrograms/L postshift. On re-evaluation of the factory following improvements in ventilation and work practices, mean time-weighted occupational exposure to TCE had decreased to 84 mg/cu m and short-term exposure to 400 mg/cu m; symptom frequency and concentrations of urinary TCE metabolites also were reduced. This episode demonstrates that community and occupational exposure to chemical toxins may share a common origin. (Author's abstract)
W88-07071

DECAY OF DISSOLVED SUBSTANCES BY SECOND-ORDER REACTION; PROBLEM DESCRIPTION AND BATCH-REACTOR SOLUTIONS,
U. S. Salinity Lab. Soil and Water Management Research Unit, Riverside, CA 92521.

S. R. Yates, and C. G. Enfield.
Journal of Environmental Science and Health JESEDU, Vol. 23, No. 1, p 59-84, January 1988. 3 fig, 1 tab, 40 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Model studies, *Groundwater pollution, *Water chemistry, *Mathematical studies, Equations, Degradation, Finite element method, Batch reactors, Chemical reactions.

The mass transport (advection-dispersion) equations allowing coupled second-order reaction between two constituents were derived and result in a set of coupled nonlinear partial differential equations. The equations that govern the transport and transformation of two reactive chemical constituents in groundwater where the influences of interconstituent reaction is allowed are presented. Several exact solutions to the coupled nonlinear equations for a stagnant flow system illustrate the second-order decay mechanism. Although the assumptions applied in developing these solutions limit their usefulness in modeling the contaminant transport process in flow fields, they do provide a means for verifying more comprehensive finite-difference or finite-element solutions to the governing equations and, more importantly, provide a means whereby the reaction coefficients for batch reactor experiments may be obtained. (Alexander-PTT)
W88-07073

SHORT-TERM EFFECTS OF ZOOPLANKTON MANIPULATIONS ON PHOSPHATE UPTAKE,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-07088

ALUMINUM, IRON, ZINC, AND LEAD IN BOG WATERS OF NORTHEASTERN NORTH AMERICA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
N. R. Urban, S. J. Eisenreich, and E. Gorham.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 6, p 1165-1172, June 1987. 3 fig, 1 tab, 51 ref. NSF Grant DEB 7922142.

Descriptors: *Heavy metals, *Water pollution sources, *Bogs, *Fallout, *Air pollution effects, *Dry deposition, *Atmospheric deposition, *Path of pollutants, Fate of pollutants, Aluminum, Iron, Lead, Zinc, Wetlands, Peat bogs, Peat, Northeastern North America, Air pollution, Evaporation.

Aluminum, iron, zinc, and lead were measured in 37 surface waters from 24 bogs along an east to west transect from Manitoba and Minnesota to Maine and the Atlantic Provinces of Canada. Large gradients increasing from east to west of Fe and Al and nearly constant concentrations of Pb and Zn were revealed. Atmospheric deposition of soil particles is the major influence on Al and Fe concentrations. Zinc and Pb are derived primarily from air pollution. Concentrations of Al and Fe in bog waters greatly exceed those in regional atmospheric precipitation; dry deposition and evaporative concentration are the likely explanations. Concentrations of Zn and Pb are less than those in precipitation, presumably due to sorption by peat. (Wood-PTT)
W88-07095

BIOACCUMULATION AND METABOLISM OF TRI- AND DIALKYLLEAD COMPOUNDS BY A FRESHWATER ALGA,
Department of Fisheries and Oceans, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Canada Centre for Inland Waters, Burlington, Ont. L7R 4A6.
P. T. S. Wong, Y. K. Chau, J. L. Yaromich, and O. Kramar.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 6, p 1257-1260, June 1987. 2 fig, 2 tab, 17 ref.

Descriptors: *Lead, *Algae, *Bioaccumulation, *Metabolism, *Path of pollutants, Chlorophyta, Dialkyllead compounds, Trialkyllead compounds, Heavy metals, Accumulation.

A freshwater green alga, Ankistrodesmus falcatus, exposed to solutions of trialkyllead, dialkyllead, and inorganic lead(II) compounds (1 milligram/liter) for 24 hours accumulated these compounds with concentration factors of about 100, 2000, and 20,000, respectively. Incubation of this alga with trimethyllead and dimethyllead species over a long period (28 days) revealed the ability of the organism to metabolize these compounds. The metabolic processes for trimethyllead followed a dealkylation sequence with the formation of dimethyllead and lead(II) compounds. The alga not only accumulated dimethyllead, but also contained significant amounts of trimethyllead and lead(II) compounds. Neither chemical disproportionation reactions nor photodecomposition could account for the quantities produced. (Author's abstract)
W88-07098

BIOGEOCHEMICAL CYCLING OF SELENIUM IN THE SAN JOAQUIN VALLEY, CALIFORNIA, USA,
Geological Survey, Menlo Park, CA.
T. S. Presser, and H. M. Ohlendorf.
Environmental Management EMNGDC, Vol. 11, No. 6, p 805-821, November 1987. 2 fig, 4 tab, 104 ref.

Descriptors: *Path of pollutants, *Irrigation-return flow, *Water pollution effects, *Selenium, *Agriculture, California, Salinity, Geohydrology, San Joaquin Valley, Irrigation effects, Wildlife, Bioaccumulation, Accumulation, Aquatic birds, Birds, Waterfowl, Toxicity, Nutrients, Pesticides, Trace metals, Heavy metals, Metals, Herbicides, Insecticides, Drainage, Mortality, Morbidity.

Subsurface agricultural drainage waters from western San Joaquin Valley, California, contained elevated concentrations of selenium, up to 1400 microgram/liter in the San Luis Drain inflows. In 1978 these drainage waters began to replace previous input to Kesterson Reservoir, a pond system within Kesterson National Wildlife Refuge. Selenium then entered the food chain. Mean concentrations in filamentous algae, rooted plants, and net plankton were 35-85 ppm; in insects and fish, 22-175 ppm, in aquatic insect larvae and nymphs, up to 175 ppm; in mosquitofish, 170 ppm; and in sediments 3.1 to 210 ppm dry weight. In the 1983 nesting system unusual rates of deformity and death were observed in embryos and hatchlings of wild aquatic birds (up to 64% of eared grebe and American coot nests). These were attributed to selenium toxicosis since testing for pesticides and trace elements showed generally low levels. Geologic setting (Cretaceous and Tertiary marine sediments), climate, soil type, availability of imported irrigation water, type of irrigation (drainage water collected and transported to the wildlife area), and the chemical properties of selenium all contributed to the high levels of selenium in the groundwater. (Cassar-PTT)
W88-07103

ANALYSIS OF AN ANISOTROPIC COASTAL AQUIFER SYSTEM USING VARIABLE-DENSITY FLOW AND SOLUTE TRANSPORT SIMULATION,
Geological Survey, Box 50166, Honolulu, HI 96850.
For primary bibliographic entry see Field 2F.
W88-07106

REGIONAL HYDRODYNAMICS OF THE PROPOSED HIGH-LEVEL NUCLEAR-WASTE REPOSITORY SITES IN THE TEXAS PANHANDLE,
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
E. S. Bair.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 149-172, June 30, 1987. 12 fig, 50 ref.

Descriptors: *Underground waste disposal, *Groundwater movement, *Path of pollutants, *Radioactive wastes, *Site selection, Hydrodynamics, Aquifer characteristics, Palo Duro Basin, Texas, Saturation zone, Salt beds, Ogallala Aquifer, Dockum Aquifer, Geohydrology, Water level, Aquitards, Potentiometric profiles, Hydraulic gradient.

Potential sites for high-level nuclear waste repositories were evaluated in the bedded salt in the Palo Duro Basin area of the Texas Panhandle. The sites are underlain by three major hydrostratigraphic units: (1) a shallow freshwater aquifer system developed in the Tertiary Ogallala Formation and the Triassic Dockum Group; (2) a thick shale and evaporite aquitard; and (3) a deep basin brine aquifer system. Water level, shut-in pressure, and specific gravity data from inventoried wells, drill-stem tests, and long-term pumping tests were used to construct potentiometric surfaces, potentiometric profiles, and pressure-depth diagrams. Water in the Ogallala and Dockum aquifers predominantly flows horizontally and discharges to springs and wells. Equipotential patterns on potentiometric profiles indicate that some water may be moving downward from the Ogallala into the Dockum across an intervening confining unit, as well as moving downward from the Dockum across the shale and evaporite aquitard and into the deep basin aquifer system. Equipotential patterns and pressure-depth data indicate predominantly horizontal flow in the deep basin aquifer system, which is influenced by permeability variations related to facies changes. Hydraulic gradients are flatter in the more permeable shelf, shelf margin, and fan-delta facies and steeper in the less permeable deep basin facies. (Cassar-PTT)
W88-07112

MICROSCALE CHEMICAL HETEROGENEITY IN GROUNDWATER,
Isotope Department, The Weizmann Institute of Science, 7100 Rehovot, Israel.
D. Ronen, M. Magaritz, H. Gvirtzman, and W. Garner.
Journal of Hydrology JHYDA7, Vol. 92, No. 1/2, p 173-178, June 30, 1987. 3 fig, 10 ref.

Descriptors: *Data acquisition, *Path of pollutants, *Groundwater pollution, *Solute transport, Wastewater disposal, Lagoons, Sludge disposal, Water quality, Monitoring, Chlorides, Nitrates, Sulfates, Test wells, Israel, Dialysis cells.

A multilayer dialysis cell device was used to obtain undisturbed, real-time samples from test wells 15 km north of Tel Aviv, Israel, and 2 km inland from the Mediterranean Sea. The test site, which overlies part of the Coastal Plain Aquifer, contains a sewage treatment plant, effluent infiltration lagoons, sludge disposal site, and fields irrigated with effluent for 20 years. Chemical profiles were obtained 42 days apart, using 76 dialysis cells over a 240-cm length. In the first test (single sampling), variations over the 240-cm length were considerable: chloride, 160-270 mg/liter; nitrate, 0-110 mg/liter; and sulfate, 45-70 mg/liter. When the same well was examined 42 days later, an entirely different pattern was found: chloride, 130-240 mg/liter; nitrate, 0-50 mg/liter; and sulfate, 10-55 mg/liter. Three-dimensional representations of the three ions measured from May 11 to October 13, 1986, further demonstrated the complexity of profiles. The results raised the question of the validity of groundwater quality data based on single samples. (Cassar-PTT)
W88-07113

TRIBUTYLTIN (TBT) IN THE WATERS OF A SCOTTISH SEA LOCH ARISING FROM THE USE OF ANTIFOULANT TREATED NETTING BY SALMON FARMS,
DAFS Marine Laboratory, P.O. Box 101, Victoria Road, Aberdeen AB9 8DB (Great Britain).
P. W. Balls.
Aquaculture AQCLAL, Vol. 65, No. 3/4, p 227-237, September 15 1987. 7 fig, 1 tab, 22 ref.

Descriptors: *Tributylin, *Antifoulant paints, *Heavy metals, *Biocide, *Dibutylin, *DBT, *Seawater, *Organotin species, Scotland, Salmon farms.

The leaching of TBT from a moored array of cages with netting freshly treated with TBT-based antifoulants has been assessed for 5 months following immersion in seawater in a sea loch. Concentrations of ca. 1 mg/cum (g/l as Sn) within the cages are observed soon after deployment. These levels dropped rapidly to ca. 0.1 mg/cum after 2 weeks and to ca. 0.005 mg/cum after 5 months. Close to the cages (20 m), concentrations up to 0.2 mg/cum were initially observed while in the main body of the loch TBT was only detectable (0.002 mg/cum) near the start of the investigation. Concentrations of TBT in seawater in and around the raft are higher than those reported to produce effects on biota in laboratory studies. Within the loch there is some evidence of decomposition of TBT to dibutylin (DBT). (Author's abstract)
W88-07117

DETERMINATION OF PARAQUAT BY FLOW-INJECTION SPECTROPHOTOMETRY,
Department of Analytical Chemistry, Faculty of Chemistry, Complutense University of Madrid, 28040 Madrid (Spain).
For primary bibliographic entry see Field 5A.
W88-07120

SOME PROBLEMS ASSOCIATED WITH BREWERY AND DAIRY WATER DISCHARGES,
Science College, Mosul University, Mosul, Iraq.
For primary bibliographic entry see Field 5C.
W88-07124

COLIFORM BACTERIAL COUNTS IN THE NILE WATER AT KHARTOUM,
Khartoum Univ. (Sudan). Faculty of Agriculture.
H. A. Dirar.
Environment International ENVIDV, Vol. 12, No. 5, p 571-576, 1986. 3 fig, 1 tab, 17 ref.

Descriptors: *Bacterial analysis, *Water analysis, *Coliform, *Fecal contamination, *Fecal coliform bacteria, *Microbiological studies, *Nile, *Sudan, Stream pollution, Bacterial, Africa.

Research data was collected to find out just how clean the Nile in the Sudan is with respect to fecal contamination. A total of more than 144 samples were taken over a period of 12 months. The clear, fast-flowing Blue Nile is much more fecally contaminated than the chalky, slow-flowing White Nile and that, in general, the Nile is much cleaner than other African rivers. (Miller-PTT)
W88-07125

PCB LEVELS IN SURFACE AND WASTE WATERS IN EGYPT,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. I. Badawy, and O. A. Aly.
Environment International ENVIDV, Vol. 12, No. 5, p 577-580, 1986. 1 fig, 3 tab, 17 ref.

Descriptors: *Polychlorinated biphenyls, *Surface water, *Water analysis, *Chemical analysis, *Wastewater analysis, *Chlorinated aromatic hydrocarbons, *Gas chromatography, *Egypt, *Nile River, *Ismailia Canal, *El-Mahmodia Canal, Comparison studies, Stream pollution.

Samples of surface water from the river Nile, Ismailia and El-Mahmodia Canals, and wastewaters from eight plants were collected and analyzed for PCB levels. The mean concentrations of PCBs in the Nile River, El-Mahmodia Canal, and wastewaters were 24 + or - 14, 39 + or - 18, and 170 + or - 150 ng/L, respectively. The wastewaters discharged from industrial plants increased the levels of PCBs in surface waters. the concentrations of PCBs in the Nile and two canals are within the range found in the Hudson, Avon, and Frome Rivers, and for the Northern Mississippi area. (Author's abstract)
W88-07126

PHYSICAL MODEL STUDY OF THERMAL AND CHEMICAL POLLUTION IN THE SHUAIBA OFFSHORE AREA OF KUWAIT,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
For primary bibliographic entry see Field 5C.
W88-07130

ENVIRONMENTAL FATE OF POLYNUCLEAR AROMATIC HYDROCARBONS IN COAL TAR,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
J. D. Enzminger, and R. C. Ahlert.
Environmental Technology Letters ETLEDB, Vol. 8, No. 6, p 269-278, June 1987. 3 tab, 58 ref.

Descriptors: *Polynuclear aromatic hydrocarbons, *Biodegradation, *Groundwater pollution, *Hydrocarbons, *Fate of pollutants, *Water pollution, *Path of pollutants, United States, Surfactants, Degradation, Coal tar.

Coal tar contains high concentrations of polynuclear aromatic hydrocarbons (PAH). Land disposal of coal tar residues has led to extensive groundwater contamination at a number of sites in the Minnesota, Virginia, Pennsylvania, and Iowa. This paper briefly reviews several case studies of coal-tar-contaminated sites. The environmental fate of PAH in coal tar residues, particularly biodegradation and transport in groundwater, is discussed. Compounds that are more hydrophobic or have higher molecular weight are more resistant to natural biological degradation any may persist in the evnironment. Unsubstituted aliphatic or aromatic hydrocarbons located in anoxic environments also will persist. Compounds that are hydrophobic will tend to move more slowly through soils that have a high organic carbon content. The presence of surfactants or dissolved organic material may increase the solubility of hydrophobic compounds, and, thus, their mobility. Several treatment processes have been shown to remove PAH from wastewater; these include trickling filters, flocculatin and sedimentation, and granular activated carbon. (Miller-PTT)
W88-07134

COMPARATIVE STUDY OF TIN PROFILES WITH OTHER METALS AND PHOSPHORUS PATTERNS IN LACUSTRINE SEDIMENTS: MOBILITY AND POLLUTION,
1 - Laboratoire de Chimie Analytique - Faculte des Sciences - Avenue de l'Universite, 64000 PAU - France.
H. El Ghobary, A. Astruc, M. Astruc, F. Giovanoli, and R. Pinel.
Environmental Technology Letters ETLEDB, Vol. 8, No. 6, p 279-288, June 1987. 7 fig, 22 ref.

Descriptors: *Tin, *Heavy metals, *Trace metals, *Lake Geneva, *Fate of pollutants, *Sedimentology, *Lake sediments, *Anoxic water, *Tin mobility, *Switzerland, *Saudi Arabia, Copper, Lead, Zinc, Phosphorus, Organic matter, Outfalls.

Tin profiles in three sediment cores of Lake Geneva were compared with patterns of mobile elements (organic matter and phosphorus) and of metals (copper, lead zinc, manganese, and iron) related to anthropogenic flux in order to estimate tin mobility, fluxes and fate in lacustrine sediments. It appears that the mobility of tin is rather low in the studied anoxic lacustrine sediments. The average tin anthropogenic flux at site M 1, adjacent to Vidy sewage plant discharge outlet, is at least 2.6 microgram/sq cm/yr. However, the average tin flux at site L 14 (255 m depth) and site l 16 (305 m depth) are 0.23 and 0.12 microgram/sq cm/yr, respectively. Therefore, the main anthropogenic source of tin is sewage and the major sink of tin in the near-shore polluted areas is particulate deposit ion, which immobilizes tin in the sediment column. (Author's abstract)
W88-07135

ASSESSMENT OF METAL SPECIES BIOAVAILABILITY AND GEOCHEMICAL MOBILITY IN POLLUTED WATERS,
Department of Engineering, Chalmers University of Technology, S-412 96 Goteborg, Sweden.
For primary bibliographic entry see Field 5A.
W88-07139

METAL SPECIATION VARIATIONS WITHIN SEPARATE STORMWATER SYSTEMS,
Urban Pollution Research Centre, Middlesex Polytechnic, Queensway, Enfield, Middlesex, England EN3 4SF.
D. M. Revitt, and G. M. Morrison.
Environmental Technology Letters ETLEDB, Vol. 8, No. 8, p 373-380, August 1987. 1 fig, 17 ref.

Descriptors: *Water pollution, *Path of pollutants, *Storm sewers, *Storm water, *Heavy metals, *Cadmium, *Copper, *Zinc, *Lead, *Sweden, *England, Urban runoff, Chelex removable fraction, Exchangeable fraction, Storm sewers, Sewer system, Chemical analysis, Metal speciation, Gully-pot.

The changes in metal speciation through separate stormwater systems for several combined storms were examined. The metal species which dominate throughout the system are the chelex removable fraction for Cd, Cu and Zn and the exchangeable fraction for Pb. The variations in individual metal species between road runoff, gullypot outflow and stormwater outfall samples were interpreted in terms of the relevant chemical and physical processes which affect the movement of metal pollutants on the road surface, within the gullypot and through the sewer pipe system under stormflow conditions. (Author's abstract)
W88-07140

RADIOACTIVE TRACER TECHNIQUES IN SPECIATION STUDIES,
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W88-07141

BIOAVAILABLE METAL UPTAKE RATE DETERMINATION IN POLLUTED WATERS BY DIALYSIS WITH RECEIVING RESINS,
Department of Sanitary Engineering, Chalmers University of Technology, S-412 96 Goteborg, Sweden.
For primary bibliographic entry see Field 5A.
W88-07142

ZERO-DEPOSITION TIME EXTRAPOLATION DPASV FOR DETERMINATION OF THE COMPLEXATION CAPACITY,
Dept of Geography, Peking University, Beijing, People's Republic of China.
For primary bibliographic entry see Field 5A.
W88-07146

SURFACE TENSION AS AN INDICATIVE PARAMETER OF POLLUTION. A WATER POLLUTION SURVEY OF THE BAY OF PASAJES,
I. Larumbe, A. Casado, and F. Izco.
Environmental Technology Letters ETLEDB, Vol. 8, No. 9, p 441-448, September 1987. 6 fig, 2 tab, 9 ref.

Descriptors: *Surface tension, *Detergents, *Water pollution sources, Dissolved oxygen, Spain, Water properties, Hydrogen ion concentration, Conductivity, Correlation coefficient, Statistical analysis.

Pure water has a surface tension value which is modified depending on the substances borne in it. The degree of contamination of the Bay of Pasajes (located in the Province of Guipuzcoa, Spain) and its relation to measured surface tension values were studied. Correlation coefficients were obtained between the surface tension and pollution load dissolved oxygen, anionic detergents, pH, and conductivity, and surface tension. The highest correlation coefficients were found for surface tension-detergent concentration and were attributed to urban water flowing into the bay. Other correlations could be explained by the presence of various industrial effluents. (Miller-PTT)
W88-07147

GASEOUS POLLUTANT AND ACIDIC RAIN IMPACTS ON CROPS IN THE UNITED STATES: A COMPARISON,
National Acid Precipitation Assessment Program, Washington, DC.
P. M. Irving.
Environmental Technology Letters ETLEDB, Vol. 8, No. 10, p 451-458, October 1987. 4 fig, 2 tab, 15 ref.

Descriptors: *Air pollution effects, *Water pollution sources, *Acid rain, *Agriculture, *Crops, *Atmospheric deposition, *Wet deposition, Simulated rain, Precipitation, Meteorological conditions, Sulfur dioxide, Nitrogen oxides, United States.

The effects of gaseous pollutants (O3, SO2, NO2) and acidic rain were assessed and compared for a wide variety of crop cultivars and species. No measurable and consistent crop yield response from the direct effects of simulated acidic rain at ambient levels has been established, although possible interactions with other stresses need further study. For some local situations, exposures of SO2 and combinations of SO2 and NO2 may reach concentrations and frequencies that could reduce crop productivity, but effects from these pollutants are not significant on a national scale. In contrast, O3 at ambient levels during the growing season, has been demonstrated to reduce the yield by an average of 5-10% for the majority of crops tested. (Author's abstract)
W88-07148

ROLE OF QUALITY ASSURANCE IN NATIONAL ACID RAIN RESEARCH IN THE UNITED STATES,
Northrop Services, Inc., Research Triangle Park, NC.
For primary bibliographic entry see Field 7C.
W88-07149

CONSTRUCTION AND EXPLOITATION OF AN AUTOMATIC SEQUENTIAL WET-ONLY RAIN SAMPLER,
Laboratoire de physico-chimie de l'atmosphere, Universite Paris 7, 2 Place Jussieu, 75251, Paris Cedex 05, France.
J. L. Jaffrezo, and J. L. Colin.
Environmental Technology Letters ETLEDB, Vol. 8, No. 10, p 467-474, October 1987. 4 fig, 7 ref.

Descriptors: *Acid rain, *Water quality data, *Sampling, *Rainfall sampling, *Aerosols, *Meteorology, *Precipitation, Automatic sequential rain sampling, Sequential sampling, France, Scavenging, Chemical analysis.

A better understanding of mechanisms by which chemical species are scavenged by precipitation can be obtained by monitoring concentrations continuously throughout an event. An automatic sequential sampling station collects rain in 0.1 mm increments, without mixing fractions or events. This station has been used in Paris for a year. Preliminary results on a particular event show the usefulness of this sampling technique when it is associated with complementary data on the aerosol and the meteorology. A second version has been developed with several improvements over this prototype. (Author's abstract)
W88-07150

NICKEL ACCUMULATION BY BACTERIA,
Department d'Enginyeria Quimica i Bioquimica, Facultat de Quimiques, Universitat de Barcelona, Placa Imperial Tarraco, 1, 43005 Tarragona, Spain.
A. Bordons, and J. Jofre.
Environmental Technology Letters ETLEDB, Vol. 8, No. 10, p 495-500, October 1987. 1 fig, 2 tab, 23 ref.

Descriptors: *Path of pollutants, *Microbiological studies, *Wastewater treatment, *Industrial wastewater, *Activated sludge, *Aerobic treatment, Sediments, *Bioaccumulation, *Bacteria, *Nickel.

A survey has been made of the accumulation of nickel by resting cells of 32 strains selected as Ni-resistant among a population of bacteria isolated from activated sludge and polluted sediments with a view to obtaining a strain suitable for removing nickel from industrial wastes. The best strain was classified as Pseudomonas and removed about 5% of the metal from the solution. Nine other selected strains were different genera of Enterobacteria. (Author's abstract)
W88-07152

MODELLING THE DYNAMIC RELATIONSHIP BETWEEN CD-CONCENTRATION IN GAMMARUS TIGRINUS AND WATER TEMPERATURE,
Oldenburg Univ. (Germany, F.R.).
H. P. Baumer, and G. P. Zauke.
Environmental Technology Letters ETLEDB, Vol. 8, No. 11, p 529-544, November 1987. 11 fig, 4 tab, 16 ref.

Descriptors: *Model studies, *Statistical models, *Computers, *Computer software, *Water pollution, *Cadmium, *Bioavailability, *Bioaccumulation, *Germany, Correlation coefficient, Water temperature.

In the context of the discussion of concepts of biological monitoring, the dynamic relationship between Cd-concentration in Gammarus tigrinus and water temperature was investigated. As a first approximation, a transfer function noise-model is proposed and its mathematical development presented. According to this model, mean monthly Cd-concentration seems to be related to the mean monthly water temperature of the previous month. The dynamic relationship between indicator variables of the life-history status of potential monitor organisms and the accumulated body burden of a given contaminant must be carefully evaluated. (Miller-PTT)
W88-07153

DISSOLVED IRON AND ORGANIC MATTER IN NORTHERN PEATLANDS,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W88-07174

ACID NEUTRALIZING CAPACITY OF LEAVES EXPOSED TO ACIDIC FOG,
California Univ., Riverside. Statewide Air Pollution Research Center.
R. C. Musselman.
Environmental and Experimental Botany EEBODM, Vol. 28, No. 1, p 27-32, January 1988. 1 tab, 44 ref.

Descriptors: *Acid rain, *Fate of pollutants, *Air pollution effects, *Acidity, *Neutralization, *Leaves, *Fog, Hydrogen Ion Concentration, Plant tissues, Tomatoes, Radish, Celery, Azalea.

Experiments were conducted to determine pH at the leaf surface of radish (Raphanus sativus), azalea (Rhododendron spp.), celery (Apium graveolens), and tomato (Lycopersicon esculentum) after 2 hr of exposure to acidic fog at pH levels ranging from 1.6 to 5.6. Results demonstrated that plants had a capacity to neutralize acidic input at the leaf surface, thus preventing exposure of plant tissue to acidity levels which might cause necrosis. The acid-neutralizing capacity was dependent upon hydrogen ion input; it was particularly evident at the higher pH levels, but was less effective at low pH. Plant species differed in their capacity to neutralize specific levels of acidic input. Acidity of moisture at the leaf surface after exposure to pH of 3.6 or higher was no more than pH 4.6 for celery to pH 5.8 for azalea. No foliar necrosis was observed at treatment levels of pH 3.6 or above. Species with similar leaf surface pH levels differed in amount of foliar necrosis; radish was injured more than celery and azalea at pH 1.6, even though surface neutralizing capacities of these three species were similar at this treatment level. The amount of leaf necrosis occurring at the pH 2.6 treatment indicates that the threshold for necrosis to develop may require surface acidity near pH 3 for radish and azalea, but closer to pH 4 for tomato; celery was not injured at pH 2.6 even though acid neutralizing capacity was the same for both celery and radish at this treatment level. (Author's abstract)
W88-07175

QUANTITATIVE DETERMINATION OF ARSENOCHOLINE AND ACETYLARSENOCHOLINE IN AQUATIC ORGANISMS USING PYROLYSIS AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
National Inst. of Environmental Medicine, Stockholm (Sweden).
A. Christakopoulos, B. Hamasur, H. Norin, and I. Nordgren.
Biomedical and Environmental Mass Spectrometry BMSYAL, Vol. 15, No. 2, p 67-74, 15 January 1988. 5 fig, 4 tab, 41 ref. Swedish Environmental Protection Board Grant 5311064-9 and Swedish Medical Research Council Grant B 86-14x-199-22.

Descriptors: *Quantitative analysis, *Arsenic compounds, *Organic compounds, *Path of pollutants, *Fate of pollutants, *Aquatic animals, *Gas chromatography, *Mass spectrometry, Algae, Marine algae, Bioaccumulation, Biosynthesis, Excretion, Arsenic, Trace levels, Crustaceans, Shrimp, Lobsters, Crabs, Fish, Sculpin, Perch, Herring, Pike, Roach, Flounders, Brackish water, Ecosystems.

Marine and limnetic algae bioaccumulate inorganic arsenic and biosynthesize organic arsenic compounds, which are excreted to the surrounding water or incorporated into the cells of the algae. A qualitative and quantitative method has been developed for the analysis of trace amounts of quaternary organoarsenicals. Using this method, arsenocholine (AsCh) and acetylarsenocholine (AAsCh) have been estimated in fish (sculpin, perch, burbot, herring, pike, and roach) from arsenic-polluted brackish water and compared with the same species of fish from unpolluted water. The investigation also includes some fish and crustacea (plaice, shrimp, lobster, crab, and witch) from marine water. The absolute concentrations of AsCh and AAsCh in fish from arsenic-polluted water indicate an elevated level of these compounds parallel to the higher total arsenic concentration in fish from polluted water compared with fish from unpolluted water. The relative concentration of AsCh and AAsCh in fish from arsenic-polluted and unpolluted water does not seem to differ; however, the relative concentrations of these compounds in marine organisms are lower than in brackish-water fish. The presence of AsCh and AAsCh in different aquatic organisms indicates the existence of a general metabolic pathway for these compounds in aquatic ecosystems. (Shidler-PTT)
W88-07179

OCCURRENCE AND CHEMISTRY OF HIGH FLUORIDE GROUNDWATERS IN JALORE DISTRICT OF WESTERN RAJASTHAN.
Ground Water Department, Jodhpur 342003, India.
S. C. Gupta, C. S. Doshi, and B. L. Paliwal.
Annals of Arid Zone ANA2BX, Vol. 25, No. 4, p 255-264, December 1986. 5 fig, 3 tab, 11 ref.

Descriptors: *Water quality, *Geochemistry, *Fluorides, *Groundwater quality, *India, Chemical analysis, Drinking water, Spectrophotometry, Calcite, Bicarbonate, Wells.

Fluoride has been a significant problem associated with groundwaters in western and southwest Rajasthan. More than 40% of the groundwaters in Pali and Jalore Districts contain fluoride in concentrations above the permissible limits of 2.0 mg/l. Groundwater samples from nearly 165 dug wells representing different hydrogeological formations in Jalore District were collected during the years 1976-1982 and analyzed chemically using APHA standard methods. The fluoride estimations were carried out spectrophotometrically using Alizarin red and Zirconium oxychloride reagents. The activity of fluoride and other related ions was calculated by the Debye-Huckle equation. The groundwaters in the region are saturated with respect to

calcite but only about 27% of them are fluoride-saturated. High fluoride waters are, in general, high in sodium and bicarbonate content; however, this relationship is not attributed to chemical thermodynamics. (Shidler-PTT)
W88-07187

SNOWMELT RUNOFF PATHWAYS IN A BOREAL FOREST HILLSLOPE, THE ROLE OF PIPE THROUGHFLOW,
Laboratory of Forest Hydrology, Department of Forest Sciences, Bureau 0866, Pavillon Vachon, Laval University, Sainte-Foy, Que. G1K 1P4, Canada.
For primary bibliographic entry see Field 2G.
W88-07191

HYDROGEOLOGY, HYDROCHEMISTRY, AND ENVIRONMENTAL ISOTOPES OF THE CAMPASPE RIVER AQUIFER SYSTEM, NORTH-CENTRAL VICTORIA, AUSTRALIA,
Geological Survey of Israel, Jerusalem.
For primary bibliographic entry see Field 2F.
W88-07193

BEHAVIOR OF VARIOUS SOLUTES IN A FIELD SOIL: SIX YEARS OBSERVATION,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 5E.
W88-07195

LINEAR GRAPHICAL METHOD FOR DETERMINING HYDRODISPERSIVE CHARACTERISTICS IN TRACER EXPERIMENTS WITH INSTANTANEOUS INJECTION,
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
H. Q. Wang, N. Crampon, S. Huberson, and J. M. Garnier.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 143-154, 15 November 1987. 6 fig, 4 tab, 15 ref.

Descriptors: *Solute transport, *Path of pollutants, *Dispersion, *Groundwater movement, *Linear graphical method, *Graphical methods, *Aquifer characteristics, *Injection, *Tracers, Estimating equations, Flow, Isotopic tracers, Mass transfer, Porous media, Porosity, Fried method, Crampon method, Sauty method.

A rapid method of determining the hydrodispersive characteristics of an aquifer from tracer experiments with instantaneous injection is proposed and applied to experimental data. This method, named the 'Linear Graphical Method', is based on the use of an analytical expression for mass transport in porous media under classic hypotheses and leads to the estimation of the dispersivity and porosity. The Linear Graphical Method was applied to one-dimensional flow in a column in the laboratory and to radial converging flow in a field experiment. The method is economical in computation time and equipment (pocket calculator, graph paper). Moreover, there is no influence of the area computation of the break-through curves as in Fried's variations method and in Crampon's method. Furthermore there is no user's influence on the break-through curve adjustment as in Sauty's type curves method. On the other hand, to avoid the influence of erratic data points on the derivative computation, it is necessary to smooth the experimental data before using this method. The results obtained by this method are in fairly good agreement with those obtained by other rapid methods. (Author's abstract)
W88-07198

BOAT TRAFFIC, SEDIMENT RESUSPENSION AND TURBIDITY IN A BROADLAND RIVER,
University of East Anglia, Norwich (England). School of Environmental Sciences.
P. N. Garrad, and R. D. Hey.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 289-297, 30 November 1987. 4 fig, 1 tab, 22 ref.

Descriptors: *Turbidity, *Suspended sediments, *Sediment erosion, *Sediment-water interfaces, *Navigable rivers, *Boating, Algal growth, River beds, Bed load, Sediment concentration, Tidal currents, Water sampling, Boating regulations, England.

Increasing levels of turbidity reported for parts of the Norfolk Broads over the last century have been attributed to algal growth. This paper demonstrates how the resuspension of bed sediments by a single moving boat is possible, and how the diurnal variation of boat traffic movement has distinct effects on patterns of suspended sediment concentration and hence turbidity. A Partech-WPRL probe was used to measure the change in concentration of suspended solids close to the river bed during the passage of a boat. Experiments using a university research boat and boats used frequently on the Broadland rivers required each boat to sail parallel to the river banks some 0, 10, and 20 m away from the instrument at speeds ranging from 1.34 m/sec to 3.12 m/sec. All the boats studied, when traveling within present speed limits (up to 3.12 m/sec), can cause erosion of the bed material and thus increase concentrations of sediment in the near-bed zone. Hourly water samples were collected above the navigable limit, in the navigable area, and in a nonnavigable tributary, using a Cygnus automatic water sampler. Suspended sediment concentration patterns for the nonnavigable stations show little diurnal variation in either the inorganic or organic fraction. Samples taken in the navigable region show distinct diurnal variations; the inorganic fraction in particular rises to a maximum in the mid-afternoon and falls to a minimum at about 7 am each day irrespective of the tide and appears to reflect the daily pattern of boat movements. Control of boat speed and frequency thus has important implications for the management of turbidity levels in Broadland. (Shidler-PTT)
W88-07207

ASBESTOS IN DRINKING WATER AND CANCER,
Department of Medical Statistics, Charing Cross and Westminster Medical School, London, England.
K. D. MacRae.
Journal of the Royal College of Physicians of London RCPJAX, Vol. 22, No. 1, p 7-10, January 1988. 29 ref.

Descriptors: *Human diseases, *Cancer, *Path of pollutants, *Epidemiology, *Population exposure, *Potable water, *Drinking water, *Diet, *Asbestos cement, *Asbestos, *Population effects, *Toxicity, *Waste discharge, *Water pollution sources, *Chemical properties, Minnesota, Connecticut, California, Washington, USA, Quebec, Canada, Pipes.

Five major epidemiological studies from Duluth in Minnesota, Connecticut, the San Francisco Bay area, the Puget Sound area of western Washington, and Quebec are reviewed. These studies identified asbestos in drinking water for one or more of the following reasons: (1) naturally occurring asbestos in the rocks in the source of the water supply; (2) contamination arising from the dumping of asbestos-containing waste; (3) the use of asbestos-cement in the pipes conveying the water to the consumer. Population density in the area, the reliability of the method of assessment (mortality or morbidity data), whether the population is rural, urban, socio-economic status, education, age, and sex are used in comparing the incidence of disease in the different populations. Methodological problems associated with physical measurement of the asbestos fiber content of water and dietary asbestos also are discussed. It is concluded that, for the majority of asbestos-pipe sites, no excess risk is present from asbestos in drinking water. (Hammond-PTT)
W88-07211

ACID PRECIPITATION AND ITS EFFECTS ON WATER QUALITY OF SMALL RIVER BASINS IN RHODE ISLAND,
Rhode Island Univ., Kingston. Water Resources Center.
For primary bibliographic entry see Field 5C.
W88-07226

ACIDIFICATION AND ANADROMOUS FISH OF ATLANTIC ESTUARIES,
Brookhaven National Lab., Upton, NY. Terrestrial and Aquatic Ecology Div.
For primary bibliographic entry see Field 5C.
W88-07255

ESTIMATING THE ATMOSPHERIC INPUT OF POLLUTANTS INTO A WATERSHED,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. J. Samson.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 7-17, September 1987. 6 fig, 3 tab, 4 ref.

Descriptors: *Water pollution sources, *Chemistry of precipitation, *Acid rain, *Acid streams, *Watersheds, United States, Water quality, Aquatic habitats, Fish, Estuarine environment, Ions, Hydrogen ion concentration, Acidity, Sulfates, Nitrates, Ammonium, Precipitation, Precipitation intensity, Storm runoff, Seasonal distribution.

Estimating the atmospheric input of ions to a watershed has traditionally been accomplished through either the extrapolation of point measurements of deposition or the integration of model-estimated deposition. The characteristics of precipitation chemistry were examined in the eastern seaboard of the United States where precipitation quality could conceivably affect fish habitats in estuaries. The measured values were extracted from the data base of the Utility Acid Precipitation Sampling Program precipitation chemistry network. These data illustrate the nature of ionic deposition at four points on the eastern seaboard. The deposition of hydrogen ions (acidity) depends upon the amount of sulfate and, to a lesser degree, nitrate in the precipitation. The quantity of ionic deposition on a storm-by-storm basis was influenced by the amount of water deposition but the relationship was not very strong. Thus the use of water deposition as a surrogate for ionic deposition is not justified in these watersheds. The deposition of hydrogen, sulfate, nitrate, and ammonium ions was not clearly seasonal. While a large percentage of total ionic deposition occurred in a small number of precipitation events, these exceptional events were not confined to a particular season. (Author's abstract)
W88-07256

COMPARISON OF EXCESS SULFATE YIELDS AND MEDIAN PH VALUES OF RIVERS IN NOVA SCOTIA AND NEWFOUNDLAND, 1971-1973 AND 1982-1984,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
M. E. Thompson.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 19-26, September 1987. 1 fig, 5 tab, 16 ref.

Descriptors: *Chemical properties, *Anions, *Sulfates, *Acidity, *Hydrogen ion concentration, *Rivers, *Water pollution sources, *Acid rain, Chemistry of precipitation, Comparison studies, Nova Scotia, Newfoundland, Areal precipitation.

Using the best available data, a comparison of the excess sulfate yields and median pH values of rivers in Nova Scotia and Newfoundland for the two periods 1971-1973 and 1982-1984 showed that the excess sulfate yields were significantly lower in 1982-1984, and the median pH values of the non-organically-dominated rivers were higher. The areal pattern of excess sulfate yields of rivers on the island of Newfoundland is in accord with the known pattern of precipitation across the island. Comparison of data for the Mersey River in Kejimkujik National Park, Nova Scotia, with measured wet deposition of excess sulfate showed that the river yields of excess sulfate are higher than the wet deposition by amounts that are likely due to dry deposition. (Author's abstract)
W88-07257

CHEMICAL AND BIOLOGICAL TRENDS ASSOCIATED WITH ACIDIC ATMOSPHERIC

DEPOSITION IN THE RHODE RIVER WATERSHED AND ESTUARY,
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 5C.
W88-07261

ANALYSIS OF ORGANIC AND INORGANIC SULFUR CONSTITUENTS AND S-34 ISOTOPES IN DATED SEDIMENTS OF FOREST LAKES IN SOUTHERN FINLAND,
Department of Chemistry, University of Oulu, SF-90570 Oulu, Finland.
P. Kokkonen, and K. Tolonen.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 157-170, September 1987. 4 fig, 6 tab, 27 ref.

Descriptors: *Water pollution sources, *Organic compounds, *Inorganic compounds, *Isotope studies, *Sulfur, *Sulfur compounds, *Fate of pollutants, *Lake sediments, Finland, Acid rain, Air pollution, Chrysophyta, Diatoms, Esters, Cores, Radioactive dating, Diagenesis.

A modification of the Jonson-Nishita digestion-distillation apparatus was used to determine the sulfur constituents of sediments from three forest lakes (Munajarvi, Orajarvi, and Sorvalampi) in southern Finland. Lakes Munajarvi and Orajarvi had undergone marked acidification during the past 30 years or so, presumably due to acid deposition as revealed from sedimentary diatom and chrysophycean remains. Organic sulfur constituted a major part of the total sulfur, and during recent years carbon-bonded sulfur increased in Lakes Munajarvi and Sorvalampi more than sulfate esters. In the case of Lake Orajarvi the concentration of total sulfur increased by a factor of 2.3 from its preindustrial level which seems to be due to an increase of both carbon-bonded sulfur and sulfate. The sediment cores of Orajarvi and Munajarvi were strongly depleted of the sulfur-34 isotope coincidentally with the upcore increase in total sulfur. This implies that the recent changes in sedimentary sulfur are related to the increasing input of airborne pollutant sulfur, since about 1850 in Orajarvi and 1950 in Munajarvi, provided that the lead-210 dating of the cores is correct and diagenetic changes have not greatly altered the vertical distribution of sulfur in these sediments. (Author's abstract)
W88-07268

SPECIFIC SORPTION OF TRACE AMOUNTS OF CU, PB, AND CD BY INORGANIC PARTICULATES,
Newcastle Univ. (Australia). Dept. of Chemistry.
T. U. Aualiitia, and W. F. Pickering.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 171-185, September 1987. 4 fig, 2 tab, 41 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chemical analysis, *Physicochemical properties, *Sorption, *Trace metals, *Heavy metals, *Copper, *Lead, *Cadmium, *Particulate matter, Inorganic compounds, Oxides, Manganese, Iron, Aluminum, Clay minerals, Suspension, Adsorbents, Hydrogen ion concentration, Metal complexes.

Thin-film anodic stripping voltammetry was used to study the specific sorption of cadmium, lead, and copper by hydrous oxides (manganese, iron, and aluminum) or clay mineral suspensions from acetate buffer solutions containing 10 - 100 micrograms/l of each metal ion. The amount sorbed varied with system pH (range 3 to 9), substrate crystal form, the ratio of adsorbent to absorbate present, and the metal ion involved. Uptake by hydrous Mn(IV) oxide was near total over the whole pH range. With other particulates the pH required for onset of sorption varied with solid phase composition, with uptake subsequently increasing steadily with increasing pH. In general, affinity and relative uptake values followed the sequences lead > copper > cadmium and Mn(IV) oxides > Fe(III) oxides > aluminum hydroxide > clays > iron ores. The solid phases loaded with sorbed metal were equilibrated with a range of extractant solutions used in soil and sediment studies, and the results confirmed that chemi-sorption was the main retention process. Significant release was achieved using extractants that attacked the substrate or formed stable complexes with the metal ion. (Author's abstract)
W88-07269

RESIDUES OF ORGANOCHLORINE PESTICIDES IN FISH FROM THE ARABIAN GULF,
Department of Environmental Marine Chemistry, Marine Science Centre, The University, Basrah, Iraq.
A. A. Z. Douabul, H. T. al-Saad, S. Z. al-Obaidy, and H. N. al-Rekabi.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 187-194, September 1987. 1 fig, 2 tab, 18 ref.

Descriptors: *Pesticide residues, *Path of pollutants, *Organic pesticides, *Fish, Persian Gulf, Iraq, Chromatography, Electron capture gas chromatography, Marine fisheries, Lakes, DDT, Endrin, Dieldrin, DDE, DDD.

High-resolution electron capture gas chromatography was used to determine residue levels of organochlorine pesticides in 13 commercially-important fish species collected from the northwestern Arabian Gulf. While most of the residues were below the detection limit of microgram/kg wet weight, relatively low concentrations of total DDT, endrin, and dieldrin were detected in the edible tissue of these fishes. The total DDT residue levels were 2 - 11 micrograms/kg wet weight, endrin, none detected - 45 micrograms/kg, and dieldrin, none detected - 5 micrograms/kg. A definite correlation was established between total organochlorine pesticide residues and lipid content for the northwestern Arabian Gulf fishes. Comparison has shown that fish from Hor-al-Hammar Lake (an area that used to be sprayed with pesticides) contained significantly higher residue levels. The total DDT residue levels were 5 - 45 micrograms/kg wet weight, endrin, 3 - 83, and dieldrin, none detected - 4 micrograms/kg. Total DDT consisted of p,p'-DDT, o,p'-DDT, o,p'DDD, and p,p-DDE; p,p'-DDT is the active pesticide form and the others are impurities or environmentally-converted forms for which p,p'-DDT is the precursor. Since unconverted DDT (p,p'-DDT) was identified in northwestern Arabian Gulf fishes, it is concluded that there has been a recent input of DDT to this region. Since DDT application has been banned in Iraq, it is assumed that the DDT must come from a more remote source or, more likely, from continuing illegal use. (Author's abstract)
W88-07270

GROUND WATER QUALITY PREDICTION USING CLIMATIC INDICES,
North Texas State Univ., Denton. Dept. of Geography.
For primary bibliographic entry see Field 2K.
W88-07276

NUMERICAL MODELING OF SOLUTE TRANSPORT PATTERNS IN THE DAMMAM AQUIFER,
Civil Engineering Department, King Fahd University of Petroleum and Minerals, Dhaharan, Saudi Arabia.
R. Al-Layla, H. Yazicigil, and R. de Jong.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 77-85, February 1988. 12 fig, 16 ref. King Abdulaziz City for Science and Technology Project AR-5-112.

Descriptors: *Numerical modeling, *Aquifers, *Saline water intrusion, *Hydraulic head, *Solute transport, Correlation analysis, Groundwater management, Groundwater recharge, Saudi Arabia, Replenishment, Water quality, Salinity, Mathematical models.

The intensive development in the Kingdom of Saudi Arabia, particularly along the coastline and in the absence of adequate replenishment sources, has led to major deterioration in the quality and quantity of groundwater resources. A numerical model of the Dammam aquifer in the Eastern Province is developed and used to predict the extent of the saline intrusion in the aquifer. The types of stresses effecting the solute transport were identified and remedial measures were suggested. The model has indicated a clear inverse relationship between hydraulic head and salinity. Anomalies exist where an increase in abstraction, and hence a diversion of relatively saline water, in one location leads to an improvement in water quality at another location. (Author's abstract)
W88-07280

EFFECTS OF NO-FLOW RIVER CONDITIONS ON THE PLATTE RIVER WELL FIELD,
Broward County Water Resources Management Division, 115 South Andrews Ave., Room 324, Fort Lauderdale, Florida 33301.
W. M. Nguyen, and M. W. Gilliland.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 103-111, February 1988. 7 fig, 15 ref.

Descriptors: *Surface-groundwater relations, *Path of pollutants, *Groundwater pollution, *River flow, *Stagnant water, *Groundwater quality, *Impaired water quality, *Groundwater movement, Velocity, Computers, Computer models, Simulation, No-flow periods, Contamination, Wells, Well hydraulics, Mathematical models, Path of pollutants, Nebraska, Hydrologic models.

Effects of no-flow river conditions on the quantity and quality of water in the Platte River well field of the City of Grand Island, Nebraska, were examined utilizing a finite-difference computer simulation model specifically developed for this well field. Results suggest that the effects of these no-flow periods eliminate the hydraulic barrier between the well field and an area north of the River that is contaminated with nitrate (concentration in the 20 to 40 mg/l NO3-N range). They also change the direction and velocity of movement of the contaminated ground water. Simulation results indicate that contaminated ground water moves toward the well field with a velocity of 0.42 ft/d after 30 days of no-flow and 1.43 ft/d after 180 days of no-flow. Limiting no-flow conditions to 10 consecutive days would protect the well field. (Author's abstract)
W88-07283

GENERATION AND QUALITY OF STREAMFLOW ON INACTIVE URANIUM TAILINGS NEAR ELLIOT LAKE, ONTARIO,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 2F.
W88-07294

EFFECT OF MONITORING WELL STORAGE ON THE SHAPE OF BREAKTHROUGH CURVES - A THOEORETICAL STUDY,
Department of Environmental Sciences, Oregon Graduate Center, 19600 NW von Neumann Drive, Beaverton, OR 97006-1999.
For primary bibliographic entry see Field 7C.
W88-07297

TIME AND FREQUENCY RESPONSE OF TRACER EXPERIMENTS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7C.
W88-07298

FIELD STUDY OF SEEPAGE AND MIGRATION PROCESSES IN FISSURED-POROUS ROCKS,
Department of Hydrogeology, Mining Institute, 22-linga Leningrad V.O. (U.S.S.R.).
V. A. Mironenko, and V. G. Rumynin.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 149-160, January 15, 1988. 12 ref.

Descriptors: *Path of pollutants, *Dispersion, *Seepage, *Geohydrology, *Hydrologic models, *Mass transfer, *Porous media, *Groundwater

movement, Hydrodynamics, Permeability, Storage capacity, Clays, Tracers.

Problems of parametric substantiation of seepage and migration (mass transfer) models for heterogeneous fissured porous rocks were studied. Principles of diagnosing the experimental curves of pumping tests factors distorting the results of their interpretation are discussed. The possibility of manifestation of nonlinear effects is considered. The specific features characterizing propagation of a hydrodynamic wave in semipervious clay strata with heterogeneous storage capacity and permeability are discussed. Recommendations for planning and interpreting tracer tests are given. The substantiation of tests requires exclusion of hydrochemical lag in hydrodispersion in fissures and the influence of regional flow. Since only a limited number of migration parameters can be studied by such tests, specialized regime observations are proposed as an alternative approach. The efficiency of this approach to the problem of studying the processes of ground water migration is demonstrated. (Author's abstract)
W88-07303

MOVEMENT OF NITRITE THROUGH A LOESS SOIL,
Department of Soil Science, Faculty of Agronomic Sciences, Catholic University of Louvain, Place Croix du Sud 2, 1348 Louvain-la-Neuve (Belgium).
F. El Etreiby, and H. Laudelout.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 213-224, February 15, 1988. 5 fig, 13 ref.

Descriptors: *Agricultural hydrology, *Groundwater pollution, *Nitrates, *Path of pollutants, *Loess, *Nitrates, *Soil chemistry, *Solute transport, Physical properties, Tritiated water, Chlorides, Aquifers, Water chemistry, Mineralization, Organic matter, Electrolytes, Mathematical studies, Porosity, Tracers.

Columns of undisturbed loess soil were used for a study of the movement of tritiated water, chloride, and nitrate, to investigate the properties of the upper one meter layer of the soil with respect to the transfer of nitrate towards the aquifer. Statistics of the values obtained regarding the Peclet number and mobile fraction in the water filled porosity showed that spatial variation of the main transfer properties was within the limits of commonly measured soil properties. The agreement between the calculated and experimental solute profile was not as good as that which was observed for the effluent. The recovery of chloride was 99% and of nitrate 115%, a difference which could have been caused by some mineralization of the organic matter in the column. In all breakthrough curves, the chloride and nitrate came ahead of tritiated water. This well-known electrolyte exclusion phenomenon was used for checking the physical validity of the nonlinear adjustment of the theoretical curves to the experimental points. Two independent determinations of the salt exclusion volume were obtained either from the movement of tritiated water and chloride through the soil or from the specific surface (corrected for charge density) of the soil at a given ionic strength. The exclusion volume, V sub excl, was found to be .063 cu cm/g. The calculation of exclusion volume from the comparison of elution curves for tritiated water and chloride was found to give .042 cu cm/g. (Author's abstract)
W88-07307

EXPERIMENTAL AND NUMERICAL STUDIES OF SOLUTE TRANSPORT IN TWO-DIMENSIONAL SATURATED-UNSATURATED SOIL,
Wuhan Institute of Hydraulic and Electric Engineering, Wuhan, Hubei (P.R. of China).
Y. Jinzhong.
Journal of Hydrology JHYDA7, Vol. 97, No. 3/4, p 303-322, February 15, 1988. 14 fig, 1 tab, 12 ref.

Descriptors: *Groundwater movement, *Saturated flow, *Unsaturated flow, *Solute transport, *Soil water, *Path of pollutants, *Model studies, *Mathematical models, Seepage, Aeration zone.

A two-dimensional saturated-unsaturated water and solute transport experiment was conducted in a soil tank under infiltration and drainage conditions. A model accounting for mobile and immobile water phases was used to describe solute transport in the soil. A Galerkin finite element model was designed to solve the transient movement of water in saturated-unsaturated soil. The seepage velocities at nodal points were obtained by using the same finite element method as for the pressure field. The solute transport equation was solved numerically in a moving and deforming coordinate system. To avoid excessive element deformation, some automatic generation schemes of the moving coordinated system have been proposed. A numerical model was used to simulate a two-dimensional saturated unsaturated experiment. The agreement for both water flow and solute transport was generally good. Experimental verification showed that the proposed numerical model can be used for the study of two-dimensional saturated-unsaturated solute transport under various conditions. (Friedmann-PTT)
W88-07312

REMOVAL OF HEAVY METALS AND SEWAGE SLUDGE USING THE MUD SNAIL, CIPANGOPALUDINA CHINENSIS MALLEATA REEVE, IN PADDY FIELDS AS ARTIFICIAL WETLANDS,
Tohoku Univ., Sendai (Japan). Biological Inst.
For primary bibliographic entry see Field 5D.
W88-07354

DISCOVERY AND ELIMINATION OF DIOXINS FROM A CARBON REACTIVATION PROCESS,
Cincinnati Water Works, OH.
For primary bibliographic entry see Field 5D.
W88-07382

EFFECT OF SOIL PROPERTIES AND A SYNTHETIC MUNICIPAL LANDFILL LEACHATE ON THE RETENTION OF CD, NI, PB, AND ZN IN SOIL AND SEDIMENT MATERIALS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. M. LaBauve, J. Kotuby-Amacher, and R. P. Gambrell.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 379-385, March 1988. 4 fig, 8 tab, 22 ref. EPA Cooperative Agreement CR-811575.

Descriptors: *Soil chemistry, *Municipal wastes, *Landfills, *Leachates, *Path of pollutants, *Sediments, *Metals, Cadmium, Nickel, Lead, Zinc, Hydrogen ion concentration.

Batch equilibrium metal immobilization studies were conducted using seven soil and sediment materials spiked with varying concentrations of Cd, Ni, Pb, and Zn. The objective was to examine the potential mobility of metals in subsoils of metals-contaminated sites. Soil pH influenced metal immobilization more than other properties. The inclusion of other property values improved correlation of retention and concentration. Among the metals, Pb was most strongly retained, while Ni was the most mobile. The presence of a synthetic municipal landfill leachate enhanced the dissolved levels of the two metals studied (Cd, Ni) in all soil materials. (Author's abstract)
W88-07423

FATE OF ADDED NITRATE AND AMMONIUM-NITROGEN ENTERING A LOUISIANA GULF COAST SWAMP FOREST,
Louisiana State Univ., Baton Rouge. Nuclear Science Center.
C. W. Lindau, R. D. De Laune, and G. L. Jones.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 386-390, March 1988. 4 fig, 1 tab, 21 ref. NSF Grant BSR-8414006 and United States Agency for International Development Grant DAN-1406-G-SS-4091-00.

Descriptors: *Fate of pollutants, *Agricultural runoff, *Municipal wastewater, *Swamps, *Nitrification, *Denitrification, *Nitrates, *Ammonium nitrogen, Louisiana.

Added nitrogen-15 labeled inorganic nitrogen was used to determine the significance of nitrification-denitrification in flooded swamp soil in removing nitrogen. Nitrogen-15 labeled (NH2)2SO4 and KNO3 were added to replicated plots in a swamp forest receiving agricultural runoff. Nitrous oxide and N2 fluxes were measured and maximum fluxes were estimated at 24g N/sq m/yr and 110 g N/sq m/yr, respectively. The capacity of the swamp forest to remove large quantities of nitrogen via nitrification-denitrification processes was demonstrated. (Author's abstract)
W88-07424

LABORATORY DETERMINATION OF DIFFUSION COEFFICIENTS OF CONTAMINANTS USING UNDISTURBED CLAYEY SOIL,
University of Western Ontario, London. Faculty of Engineering Science.
R. K. Rowe, C. J. Caers, and F. Barone.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 1, p 108-118, February 1988. 16 fig, 4 tab, 31 ref. NSERC Grant A1007 and NSERC Strategic Grant G0921.

Descriptors: *Path of pollutants, *Groundwater, *Soil contamination, *Soil water, *Clays, *Groundwater, *Advection, Diffusion coefficient, Distribution coefficient, Porosity, Leachates, Soil moisture.

A technique for determining the diffusion coefficient for contaminants using saturated, intact (undisturbed) clayey soil samples is illustrated with reference to a number of laboratory tests involving advective-diffusive migration of potential contaminants through an intact clayey soil from Sarnia, Ontario. An important aspect of the proposed technique is that the mass of contaminant in the system is kept constant and so significant decrease in source leachate concentration occurs during each test. A simple theoretical model is used to analyze this case and it is shown that this phenomenon can be used to deduce both the diffusion coefficient and the distribution/partitioning coefficient from a single test. Parameters are deduced for a number of salt solutions passing through the clay from the Sarnia area. On the basis of these tests it is suggested that for the Sarnia soil and advective velocities up to the maximum examined (0.035 m/yr), mechanical dispersion does not measurably affect the magnitude of the 'coefficient of hydrodynamic dispersion' (i.e., there is no significant dispersion). It is also suggested that the effective porosity corresponds to that deduced from the water content of the soil. (Author's abstract)
W88-07427

SHORELINE IMPACT FROM OCEAN WASTE DISCHARGES,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 5E.
W88-07429

BUOYANCY FLOW AT A TWO-FLUID INTERFACE IN A POROUS MEDIUM: ANALYTICAL STUDIES,
California Univ., Berkeley. Earth Sciences Div.
G. Hellstrom, and C. F. Tsang.
Water Resources Research WRERAO, Vol. 24, No. 4, p 493-506, April 1988. 19 fig, 26 ref, 8 append. DOE Contract DE-AC03-76SF00098.

Descriptors: *Path of pollutants, *Injection wells, *Temperature effects, *Groundwater pollution, *Buoyancy flow, *Porous media, *Two-fluid interface, Aquifers, Injection wells, Groundwater, Temperature gradient.

Analytical solutions for the pressure distribution and the flow field were derived for several idealized situations involving an injection well and a vertical plane or cylindrical interface between two fluids of different density and viscosity in an infinite anisotropic aquifer bounded by two horizontal

planes. The interface, or transition zone, between the two fluids may be either sharp or of finite width. The buoyancy flow induced by the density difference will cause the two-fluid interface to tilt. A characteristic time scale for the buoyancy tilting rate was deduced. The conditions at the well have only a small influence on the buoyancy flow except very close to the well. The buoyancy flow decreases with increasing width of the transition zone. (See also W88-07440) (Author's abstract)
W88-07439

COMBINED FORCED-CONVECTION AND BUOYANCY FLOW AT A TWO-FLUID INTERFACE IN A POROUS MEDIUM: ANALYTICAL STUDIES,
California Univ., Berkeley. Earth Sciences Div.
G. Hellstrom, C. F. Tsang, and J. Claesson.
Water Resources Research WRERAO, Vol. 24, No. 4, p 507-515, April 1988. 7 fig, 2 tab, 5 ref, append. DOE Contract DE-AC03-76SF00098.

Descriptors: *Path of pollutants, *Groundwater pollution, *Forced connection, *Buoyancy flow, *Injection wells, *Temperature effects, *Porous media, *Two-fluid interface, Aquifers, Injection wells, Groundwater.

The motion of a two-fluid interface in an aquifer is a combination of buoyancy flow and forced convection. The buoyancy flow, which is due to density variations of the fluid, and the forced convection, which acts on the viscosity variations, will cause the two-fluid interface to tilt. The basic case of a plane interface between two immiscible fluids of different density and viscosity in an infinite anisotropic aquifer bounded by two horizontal planes was analyzed. The groundwater flow in the aquifer is treated as a superposition of buoyancy flow and forced convection. The buoyancy flow and the forced-convection components are shown by analytical methods to be related to each other. The tilting angle of the two-fluid interface is given by a simple formula containing only two parameters. There exists a certain stationary tilting angle, the stability of which depends on the two viscosities. (See also W88-07439) (Author's abstract)
W88-07440

PROCESSES AFFECTING THE DISTRIBUTION OF SELENIUM IN SHALLOW GROUNDWATER OF AGRICULTURAL AREAS, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA.
S. J. Deverel, and R. Fujii.
Water Resources Research WRERAO, Vol. 24, No. 4, p 516-524, April 1988. 13 fig, 1 tab, 31 ref.

Descriptors: *Agricultural runoff, *Water pollution sources, *Path of pollutants, *California, *Groundwater pollution, *Water chemistry, *Selenium, *San Joaquin Valley, Heavy metals, Isotope studies, Irrigation water, Salts, Salinity, Root zone.

A study was undertaken to evaluate the processes affecting the chemistry of shallow groundwater associated with agricultural drainage systems in the western San Joaquin Valley, California. The study was prompted by a need for an understanding of selenium mobility in areas having high selenium concentrations in shallow groundwater. Groundwater samples were collected along transects in three artificially drained fields where the age of the drainage system varied (15, 6, and 1.5 years). Selenium concentrations in the drain water also varied (430, 58, and 3700 micrograms/L, respectively). Isotopic enrichment and chemical composition of the groundwater samples indicated that saline- and selenium-enriched water has evolved as a result of evaporation or transpiration of groundwater. This evaporated, isotopically enriched water is being displaced by more recent, less saline irrigation water percolating through the root zone. This displacement seems to be a process whereby sodium chloride and sodium sulfate water is being replaced by more dilute calcium sulfate and calcium bicarbonate water. (Author's abstract)
W88-07441

PSEUDOPOTENTIAL FUNCTIONS IN CONSTRUCTION OF FLOW NETS FOR CONTAMINANT TRANSPORT MODELING,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
G. B. Matanga.
Water Resources Research WRERAO, Vol. 24, No. 4, p 553-560, April 1988. 6 fig, 11 ref, 2 app.

Descriptors: *Pseudopotential lines, *Model studies, *Groundwater pollution, *Groundwater movement, *Path of pollutants, *Flow nets, *Porous media, Transport, Simulation, Anisotropy, Hydrology.

Construction of flow nets in most hydrogeologic field problems is complicated by nonexistence of orthogonality between streamlines and hydraulic head lines in anisotropic porous media. The nonexistence of orthogonality can be circumvented by transformation of the anisotropic porous medium into an isotropic one. Flow nets are valuable in generation of a numerical solution grid for a contaminant transport equation formulated along the direction of flow and the direction orthogonal to flow. Effect of flow domain transformation on contaminant transport simulation is not known. The flow domain transformation can be avoided by constructing flow nets with streamlines and pseudopotential lines. The pseudopotential lines are based on the theory of pseudopotential function. A discussion of the theory in isotropic porous media exists in literature. This is the first time that the theory is being extended to anisotropic porous media. An integration procedure is used to evaluate values of pseudopotential function and hydraulic head along a streamline. A comparison of flow nets based on pseudopotential lines and hydraulic head lines indicates that pseudopotential lines are more useful than hydraulic head lines in simulation of contaminant transport in saturated groundwater flow systems. (Author's abstract)
W88-07445

EXPLANATION OF SCALE-DEPENDENT DISPERSIVITY IN HETEROGENEOUS AQUIFERS USING CONCEPTS OF FRACTAL GEOMETRY,
Nevada Univ. System, Reno. Desert Research Inst.
S. W. Wheatcraft, and S. W. Tyler.
Water Resources Research WRERAO, Vol. 24, No. 4, p 566-578, April 1988. 13 fig, 50 ref. DOE Grant DE-FG08-85-NV10461.

Descriptors: *Model studies, *Path of pollutants, *Groundwater pollution, *Groundwater movement, *Geologic fractures, *Stream tubes, Stochastic process, Mathematical studies, Field tests, Calibrations, Dispersivity, Aquifers, Advection, Tracers.

Stochastic transport theories rely on the assumption that the principles of stationarity and ergodicity are satisfied. These assumptions imply that the pattern of heterogeneity can be viewed as being spatially periodic, thus yielding a finite correlation scale. A type of heterogeneity was examined which does not satisfy these principles; self-similar, or fractal heterogeneity, which exhibits a pattern (over a large range of scales) that is independent of the scale of observation and thus will possess a very large correlation scale. The basic concepts of fractal geometry are reviewed and scaling relationships for fractal travel distance versus scale of observation are developed. Lagrangian models for dispersion in a single fractal streamtube and for a set (or bundle) of fractal streamtubes were developed. The results were compared to classical one-dimensional advection-dispersion theory, existing fractal and stochastic theories, and to a summary of field-measured dispersivity data. For the single streamtube model, field-measured dispersivity is proportional to the straight-line travel distance raised to a power of D - 1, where D is the fractal dimension. For the set of fractal streamtubes, field-measured dispersivity is proportional to the straight-line travel distance raised to a power of 2D - 1. The analytical expressions are verified and elaborated by a fractal random walk computer model. The computer model was used to show the self-similar nature of heterogeneity that is independent of the scale of observation. Comparisons of the field dispersivity data with fractal models indicate that most tracer tests have been performed in media that approximate a set of fractal streamtubes. (Author's abstract)
W88-07447

INTERNAL INCONSISTENCIES IN DISPERSION-DOMINATED MODELS THAT INCORPORATE CHEMICAL AND MICROBIAL KINETICS,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, and M. A. Widdowson.
Water Resources Research WRERAO, Vol. 24, No. 4, p 615-619, April 1988. 9 fig, 1 tab, 10 ref. EPA Assistance Agreement CR 813647010.

Descriptors: *Model studies, *Groundwater pollution, *Path of pollutants, *Water chemistry, *Microbial degradation, *Dispersivity, Prediction, Mathematical studies, Microorganisms, Transport, Groundwater, Aquifers.

Current understanding of transport processes in aquifers is limited by lack of precise point chemical concentration measurements. Recently, however, some careful measurements of vertical chemical concentration profiles have been made at several locations around the world that appear to support a consistent picture concerning the persistence of large vertical concentration gradients in aquifers and, by implication, the existence of very small vertical transverse dispersivities. These data were obtained in aquifers supporting microbial activity. Data analysis using a mathematical model which considers microbial degradation coupled to nutrient and oxygen transport indicates that a vertical transverse dispersivity on the order of 0.1 cm or less is consistent with the concentration gradients that were measured. The existence of such large gradients and low dispersivities is not consistent with the use of two-dimensional vertically averaged (areal) models as currently applied, especially if one is interested in the development of transport models with predictive capability beyond that associated with standard calibration and extrapolation. Even three-dimensional models with large vertical transverse dispersivities compared to those measured will produce results inconsistent with measurements. Microbial-chemical activity is very sensitive to concentration distributions. Smearing of the oxygen profile can result in the prediction of aerobic activity where, in fact, none exists. (Author's abstract)
W88-07452

AVAILABILITY OF ORGANIC CHEMICALS FOR BIODEGRADATION IN SETTLED BOTTOM SEDIMENTS,
Environmental Safety Dept., Ivorydale Technical Center, Procter and Gamble Co., Cincinnati, Ohio 45217.
R. J. Shimp, and R. L. Young.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 1, p 31-45, February 1988. 3 fig, 3 tab, 19 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Organic compounds, *Sediments, *Adsorption, *Bacteria, Model studies, Mixing.

Biodegradation rates for dodecyltrimethylammonium chloride (TMAC), a quaternary ammonium compound, and phenol were measured in settled sediments to determine if adsorbed chemicals were directly available for biodegradation by sediment-associated bacteria. In settled sediment cores, biodegradation rates for TMAC, which is charged at environmental pH, was a function of the amount of unadsorbed chemical; adsorbed material was not directly degraded by the sediment-associated bacteria. However, the rate of biodegradation of adsorbed phenol, a relatively hydrophobic and neutral chemical, was apparently a function of the total concentration of material present, suggesting that at least a fraction of the adsorbed material was directly degraded. These results indicate that chemical structure and, possibly, the mechanism of adsorption may influence biodegradation in sediments. Studies on TMAC biodegradation in completely mixed sediment/water slurries (up to 10 g/

liter sediment) showed that TMAC biodegradation in slurries differed from that in settled sediments. Biodegradation in slurries was a function of the total amount of material present, both adsorbed and unadsorbed. These results suggest that biodegradation in settled sediments may be influenced by high concentrations of sediment present and/or the lack of mixing. Thus mixed, low-sediment-level slurries may not be realistic surrogates for modeling biodegradation processes in settled bottom sediments. (Author's abstract)
W88-07471

ORIGIN AND COMPOSITION OF SAMOAN ACID PRECIPITATION,
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
U. Dayan, and D. W. Nelson.
Tellus TELLAL, Vol. 40B, No. 2, p 148-153, April 1988. 5 fig, 4 tab, 15 ref.

Descriptors: *Water pollution sources, *Pollutant identification, *Acid rain, *Hydrogen ion concentration, *Path of pollutants, *Samoa, *Rainfall, Seasonal variation, Storms, Weather, Anions.

Samoan precipitation events are both plentiful and well distributed throughout the year. The chemistry of this rain, determined from weekly samples from 1980 to 1983, shows that the annual fluctuations of free acidity are almost negligible. The 3-year pH is 5.3, with no significant yearly trend. Classification using trajectory analyses of storm events that originated from westerly sources and occurred mainly during the March-April austral fall period, have revealed consistently poorer equivalent ion balance, e.g., anion deficits of 10 micro-eq/L larger than observed from other sources. The austral spring period (October-November) is characterized by very steady, strong, easterly trade winds and the ocean is probably the primary source of aerosol. Decreases of acidity are also observed in samples measured first in the field and then in the laboratory, suggesting the existence of another contributor of free protons in Samoan precipitation in addition to the long-range transport of sulfate aerosols. Air masses arriving from westerly sources and associated with precipitation events had almost 25% of their points of origin in the New Guinea area. It is speculated that during these flows, organic acids may be transported to Samoa. (Author's abstract)
W88-07480

THERMODYNAMIC SOLUBILITY RELATIONSHIPS OF INORGANIC VANADIUM IN THE MARINE ENVIRONMENT,
Water Resources and Environment Div., Research Inst., King Fahd Univ. of Petroleum and Minerals, Dhahran 31261 (Saudi Arabia).
M. Sadiq.
Marine Chemistry MRCHBD, Vol. 23, No. 1-2, p 87-96, February 1988. 5 fig, 2 tab, 23 ref.

Descriptors: *Hydrogen ion concentration, *Speciation, *Path of pollutants, *Oil spills, *Toxicity, *Heavy metals, *Water chemistry, *Vanadium, *Solubility, Seawater, Oxides, Metals.

Thermodynamic solubility isotherms of vanadium minerals and solution species were simulated to illustrate the solid phase formation and solution chemistry of vanadium in the marine environment. In highly reducing marine environments (pe + pH < 5), V(III) oxide is the most stable whereas in moderately reducing environments (pe + pH = 5-9), V(IV) oxides, i.e., VO2(c) and V2O4(c), are the most insoluble minerals. In oxidizing marine environments (pe + pH > 9), V(V) minerals are the most insoluble. Lead vanadates are the most stable, however, concentrations of Pb in the marine environment seem too low to control the concentration of V in seawater. It was therefore concluded that Ca vanadates (Ca(VO3)2) control the solubility of V in seawater. Other V minerals considered in this study are metastable with respect to the minerals discussed. Vanadium(V) species are important in seawater with pe + pH > 5. The distribution of these chemical forms is pH-dependent. In oxidizing aqueous systems (pe + pH > 9), H3 VO4(0), H2VO4(-) and HVO4(2-) are important below pH 4, between pH 5 and 8, and between pH 9 and 12, respectively. As the environment becomes progressively more reducing the proportions of V(III) and V(IV) species increase. However, the total concentration of V in seawater decreases as conditions become more reducing. (Author's abstract)
W88-07485

DISTRIBUTION AND POSSIBLE SOURCES OF SOME ELEMENTS IN THE SEDIMENT CORES OF THE SOUTHERN BALTIC,
Dept. of Analytical Chemistry, Medical Academy, al. K. Marksa 107, PL 80-416 Gdansk (Poland).
P. Szefer, and B. Skwarzec.
Marine Chemistry MRCHBD, Vol. 23, No. 1-2, p 109-129, February 1988. 1 fig, 8 tab, 83 ref.

Descriptors: *Sediment cores, *Baltic Sea, *Heavy metals, *Path of pollutants, *Eutrophication, Water pollution sources, Sediments, Gdansk Bay, Baltic Sea.

Sediment cores (50 samples) collected from four stations of the southern Baltic in July 1980 were analyzed for the elements Ca, Mg, Na, K, Al, Ti, Fe, Mn, Zn, Cd, Cu, Co, Ni, Pb, U, Th, C(org), N and P. Among the trace metals, only Mn shows high regional variations in its mean concentrations; lower regional-dependent changes were observed for Pb and Cu. Within the cores taken from the Gdansk Bay (station P-2) some trace metals were characterized by higher concentrations towards the surface; the mean concentrations of Pb, Cd, Zn and Cu increased relative to the geochemical background (below 15 cm) about 3.2-, 2.6-, 2- and 2-fold, respectively, while the other trace metals remained unchanged. Based on the C/N values obtained for the topmost 5 cm, it appears that the contribution of terrigenous components is smaller at station P-10 than at the other stations investigated. The relatively high increase of the N and P in the upper layers may reflect both the degradation in top sediment layers and increasing eutrophication of the southern Baltic during the last 25 years. The mean anthropogenic flux of Zn, Pb, Cu and Cd was estimated as 51, 55, 9, and 0.7 mg/sq m/yr, respectively; mean residence time in the Gdansk Basin water column of 8.7 years was inferred for Zn, 0.59 for Pb, 1.6 for Cu and 3.6 for Cd. On the basis of the enrichment factors (sea salt corrected) with respect to Fe as a normalizer as well as anthropogenic factors, two major sources for the metals in surface sediments of the Gdansk Bay can be distinguished, i.e. a terrestrial source for Al, Fe, Ti, Th, Ni, Co, K, Ca, Mg, U and Mn, and an anthropogenic source for Zn, Pb, Cu and Cd. (Author's abstract)
W88-07486

TRANSFER FUNCTION MODEL FOR THE PREDICTION OF NITRATE LEACHING UNDER FIELD CONDITIONS,
Oxford Univ. (England). Dept. of Plant Sciences.
R. E. White.
Journal of Hydrology JHYDA7, Vol. 92, No. 3-4, p 207-222, July 15, 1987. 4 fig, 1 tab, 21 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Soil chemistry, *Nitrates, *Leaching, *Mathematical models, *Solute transport, Rainfall, Probabalistic process, Mole drainage, Stochastic process, Drainage, Tile drainage, Chloride, Probability distribution.

Nitrate leaching by rainfall in a mole-and-tile drained clay soil catchment was monitored over several seasons. Sample realizations of the stochastic leaching process were observed for individual rainfall events of varying intensity and duration. Rainfall was treated as a pulse input to the soil volume within which existed an operationally defined transport volume, Vst. Within Vst. solute could experience various physical, chemical, and biological reactions on its passage to the drains. The probability density functions of solute travel times were determined from the normalized rates of loss of chloride or nitrate to the drains. The composite probability density functions for the whole system (soil plus drains) conformed to a lognormal distribution and could be deconvoluted by equating the mean travel time from the surface to mole drain depth to the difference between the overall mean travel time and the mean travel time in the drains alone, The fractional transport volume for each transport event was calculated from the mean rainfall intensity the mean travel time and the depth of the mole drains Vst was calculated from the fractional transport volume and the whole soil volume. An equation giving the quantity of N leached during each event was developed using Vst from the transfer function, the cumulative draining during an event and the initial soil nitrate concentration. The relationship between calculated N leached and the measured amounts of N leached for 10/11 events was virtually 1:1. The exceptional event had a long input of very low intensity rainfall. The calculated N leaching, obtained using a value of the fractional transport volume averaged over all 11 events, and calculated N leached obtained when the ratio of total rainfall to mean drainage was used to predict t sub L for each event, were closely related to measured N leaching for 10/11 events. The transfer function approach could be used to predict nitrate leaching losses under various field conditions, provided that the value of the initial soil nitrate concentration at the start of the leaching season was known and estimates of any major mineral gains or losses by other processes during the season could be made. (Author's abstract)
W88-07511

ORIGINS OF SEAWATER INTRUSION IN A COASTAL AQUIFER - A CASE STUDY OF THE PAJARO VALLEY, CALIFORNIA (USA),
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2L.
W88-07521

NITRATE NITROGEN IN THE BELGIAN COURSE OF THE MEUSE RIVER - FATE OF THE CONCENTRATIONS AND ORIGINS OF THE INPUTS,
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. of Analytical Chemistry and Mass Spectrometry.
B. Dermine, and L. Lamberts.
Journal of Hydrology JHYDA7, Vol. 93, No. 1-2, p 91-99, August 15, 1987. 7 fig, 3 tab, 15 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Nitrates, *Nitrogen, *Water pollution sources, *Seasonal variation, *Mathematical models, Model studies, Rivers, Pollutants, Nitrate budget, Potable water, Meuse River, Belgium.

For more than two years, a study of nutrient loads was carried out on the Belgian part of the Meuse River. It was undertaken to specify the origin and influence of the nutrient inputs. Special interest was given to nitrate nitrogen. An evolution of nitrate concentrations was observed along the river as well as a seasonal variation. By studying the discharge-concentration relationships, a major input was identified from soil leaching for discharges < 150 cu m/s, depending on many characteristics and showing great dispersion. For higher discharges, the concentrations decrease by dilution with surface runoff of lower NO3(-) content. A model for calculation of the annual NO3 (-) N fluxes is presented which permits one to trace specific inputs and losses and to quantify the dependence between the river and its watershed. On that basis, a nitrate budget for the Belgian course of the Meuse has been drawn up. (Author's abstract)
W88-07527

NITRIFICATION IN ONTARIO STREAM SEDIMENTS,
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W88-07539

FORMATION OF TRICHLORONITROMETHANE (CHLOROPICRIN) AND CHLOROFORM IN A COMBINED OZONATION/CHLORINATION TREATMENT OF DRINKING WATER,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5F.
W88-07542

ALUMINUM SPECIATION IN ACIDIC NATURAL WATERS: TESTING OF A MODEL FOR AL-HUMIC COMPLEXATION,
Freshwater Biological Association, The Ferry House, Ambleside, Cumbria LA220LP, United Kingdom.
E. Tipping, C. Woof, C. A. Backes, and M. Ohnstad.
Water Research WATRAG, Vol. 22, No. 3, p 321-326, March 1988. 1 fig, 4 tab, 26 ref.

Descriptors: *Acid rain effects, *Path of pollutants, *Chemical reactions, *Aluminum, *Acidic water, *Complexation, *Humic acids, Mathematical studies, Speciation, Model studies, Organic matter.

Concentrations of organically-complexed monomeric aluminum in field samples were compared with those predicted from an equation. Results for 114 field samples (Al-organic complex at concentrations of 0-10 microM) collected from 8 locations in Europe and North America. A satisfactory agreement between measured and predicted values was obtained. Several possible applications of the model were discussed. (1) The need to perform Al fractionations in water analysis may be reduced, and a check on fractionation results is available. (2) The prediction of Al water chemistry could be incorporated into models that describe the influence of depositional inputs to a catchment in terms of soil chemistry and hydrology. (3) Predictions of Al speciation could be helpful in preparing experimental solutions for biological tests on biota. and (4) Al speciation, and therefore toxicity, can be predicted during neutralization of acid lakes. (Cassar-PTT)
W88-07543

COMPLEXATION OF METALS WITH HYDANTOINS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
G. Z. Pavlovich, and R. G. Luthy.
Water Research WATRAG, Vol. 22, No. 3, p 327-336, March 1988. 4 fig, 4 tab, 36 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Hydantoins, *Complexation, *Industrial wastewaters, *Coal gasification, Wastewater, Metals, Dimethylhydantoin, Silver, Cadmium, Cobalt, Nickel, Copper, Zinc, Cooling water, Water reuse.

The nature of the complexation interactions between metals and 5,5-dimethylhydantoin was explored. This compound is formed during coal gasification during gas quenching and tar separation. Since it does not readily biodegrade, it can accumulate to 0.1 mol/liter when recycling treated gas liquor as makeup water for evaporating cooling. Stability constants were determined for the compound and metals by potentiometric titration, polarography, and specific ion electrode techniques. These showed that under alkaline conditions the hydantoin behaves as a weak acid and it complexes with metals as an anion. Metals used in the study were silver, cadmium, cobalt, nickel, copper, and zinc. The stability constants for calcium complexes with hydantoin and 5,5-dimethylhydantoin were small in comparison to the heavy metals. (Cassar-PTT)
W88-07544

PHOSPHORUS RELEASE FROM THE PEATY SEDIMENTS OF THE LOOSDRECHT LAKES (THE NETHERLANDS),
Limnological Institute, Vijverhof Laboratory Rijksstraatweg 6, 3631 AC Nieuwersluis, The Netherlands.
For primary bibliographic entry see Field 5G.
W88-07548

PRECIPITATION AND STREAMWATER CHEMISTRY IN A SUBARCTIC SCOTTISH CATCHMENT,
Institute of Hydrology, Wallingford (England).
D. M. Cooper, E. M. Morris, and C. J. Smith.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 221-240, September 15, 1987. 5 fig, 5 tab, 31 ref.

Descriptors: *Acid rain, *Soil chemistry, *Rainfall, *Water pollution sources, *Rainfall-runoff relationships, *Streams, *Snowmelt, *Chemistry of precipitation, *Catchment areas, *Pollutants, Ions, Soil water, Precipitation, Scotland, Data collection, Rainfall intensity.

The results of a survey of the major-ion chemistry of precipitation and streamwater at a small high-altitude catchment in Scotland are presented. Data collected at approximately weekly intervals for a year and a half demonstrate the importance of the flushing of solutes during early snowmelt in producing short-lived very acid pulses in stream water. Soil acidification is shown not to be proceeding rapidly in the catchment, the minor leaching of base cations observed being explained by primary weathering of the underlying granite. Most streamwater is shown to be generated by piston flow, even after heavy rain, and achieves a pH of about 5.2. Only during heavy rainfall and snowmelt is there more rapid runoff, with the increased streamwater conductivity during snowmelt being a direct consequence of fractionation. (Author's abstract)
W88-07561

RESPONSE OF INPUT AND OUTPUT OF WATER AND CHLORIDE TO CLEARING FOR AGRICULTURE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07568

ENVIRONMENTAL ISOTOPE HYDROLOGY OF SALINIZED EXPERIMENTAL CATCHMENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07572

MODELS OF THE EFFECT OF CLEARING ON SALT AND WATER EXPORT FROM A SMALL CATCHMENT,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W88-07576

ANALYSIS OF SULFUR-CONTAINING COMPONENTS OF A SOIL TREATED WITH SIMULATED ACID RAIN,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
G. W. Vanloon, G. W. Hay, and R. H. Goh.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 233-240, July 1987. 1 fig, 2 tab, 35 ref. Canada Dept. of Supplies and Service Contract ISU 80-00350.

Descriptors: *Water pollution sources, *Acid rain, *Path of pollutants, *Simulated rainfall, *Sulfur compounds, Soil horizons, Soil analysis, Nutrients, Rainfall.

Samples of the LFH and Bfh horizons of an Orthic Humo-Ferric Podzol were analyzed for S components after irrigation with simulated acid rain solutions of pH 5.7, 3.5, and 2.0 for 720 days. Organic S was preponderant. In the LFH horizon, the mass ratio of ester sulfate:carbon-bonded S was approximately 1:1 for samples treated with solutions of pH 5.7 and 3.5; for the sample treated with the pH-2.0 solution, the ratio was about 2:1 and the concentrations of both inorganic sulfate and ester sulfate were markedly higher. In the Bfh horizon, carbon-bonded S was the major form of organic S, except in the sample subjected to the high-acid (pH 2.0) simulated rain. The organic S components were further separated into chloroform-soluble, aqueous trifluoroacetic acid-soluble, and residual fractions. Significant increases in inorganic sulfate, both water soluble and adsorbed were found after the pH-2.0 treatment. (Author's abstract)
W88-07588

SURVEY ON YERSINIA ENTEROCOLITICA AND RELATED BACTERIA IN SHELLFISH,
Yersinia Reference Center, 3rd Dept. of Pediatrics, 'La Sapienza' Univ. of Rome, Inst. of Experimental Medicine CNR, Rome, Italy.
For primary bibliographic entry see Field 5A.
W88-07589

DISTRIBUTION OF ZN IN A NORTHWESTERN MEDITERRANEAN RIVER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
L. H. Ngoc, N. Whitehead, and B. Oregioni.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 315-324, July 1987. 2 fig, 4 tab, 16 ref.

Descriptors: *Zinc, *Rivers, *Path of pollutants, *Rhone River, Estuaries, Particulate matter, Heavy metals, Sediments, Industrial wastewater.

Determination of Zn in the aqueous, suspended and sedimentary phases of the Rhone River was carried out by differential pulse anodic stripping voltammetry with static mercury drop electrode. For total desorbable Zn (operationally defined as that measured in unfiltered water at pH 1.5 to 2) the concentration was 2.0 + or - 0.6 micrograms/L in unfiltered upstream water (8 stations) and in the unfiltered delta water (2 stations) was 1.05 + or - 0.25 micrograms/L. The delta values were slightly higher than values found recently for estuaries of other rivers such as the Amazon and Yangtse, but non-delta values correspond mainly with those from relatively unpolluted areas. Overall, in non-delta water about 35% of the Zn was in true solution, 25% adsorbed on suspended material and 40% was in the suspended material but not desorbable. The calculated K sub d for Zn on the suspended material was about 2.5E4. The Zn content in suspended matter including adsorbed Zn was 69 + or - 33 mg/kg, much lower than other literature values, and is approximately equivalent to the concentration in fine sediment fractions. The Zn in Rhone river sediment was 40 times the amount from nearby non-industrialized areas such as the Roya river. (Author's abstract)
W88-07593

INTERSPECIFIC DIFFERENCES IN DEAD PLANT BUFFERING CAPACITY ALTER THE IMPACT OF ACID RAIN ON DECOMPOSITION RATES IN TIDAL MARSHES,
Delaware Univ., Lewes. Coll. of Marine Studies.
J. L. Gallagher, L. A. Donovan, D. M. Grant, and D. M. Decker.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 4, p 339-346, August 1987. 2 fig, 14 ref.

Descriptors: *Water pollution sources, *Tidal marshes, *Path of pollutants, *Detritus, *Food chains, *Acid rain, *Simulated rainfall, *Marshes, *Spartina, *Carex, *Microbiological studies, *Biodegradation, Hydrogen ion concentration, Buffering, Population exposure, Degradation, Brackish water.

Simulated acid rain did not alter respiration rates of microbial associations on dead Spartina alterniflora from Delaware salt marshes or on dead Carex lyngbyei from Oregon brackish marshes. Since these dead plant-microbe associations have a strong buffering capacity for acid rain, the microbial associations did not experience a low pH. In contrast, Phragmites australis has a low buffering capacity and microbial respiration was reduced at least 25% by acid rain. When dead plant-microbe associations from freshwater marshes and various terrestrial plant populations were immersed in simulated acid rain, the rain water equilibrated at pH's

from 3.9 to 5.0 and were characteristic of the various species. The different buffering capacities of such dead plant-microbe associations may explain the inconsistent results published from decomposition studies and may serve as a quick and easy method of assessing the probable impact of acidic deposition on decomposition processes. (Author's abstract)
W88-07595

AEROSOL AND CLOUDWATER PROPERTIES AT WHITEFACE MOUNTAIN, NEW YORK,
National Oceanic and Atmospheric Administration, Boulder, CO. Air Resources Lab.
C. C. Van Valin, D. L. Wellman, and L. P. Stearns.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 4, p 369-383, August 1987. 6 fig, 4 tab, 26 ref.

Descriptors: *Acid rain, *Sulfates, *Aerosols, *Cloudwater, *Water pollution sources, *Path of pollutants, *Scavenging, Physical properties, Hydrogen ion concentration, Ions, Nitrates.

A field program for the measurement of the physical and chemical properties of aerosols and clouds was conducted at Whiteface Mountain, N. Y., during an 8-week period in June, July, and August 1983. Analysis of two-stage Nuclepore filter samples by proton-induced X-ray emission (PIXE) spectroscopy showed that most (85 to 90%) of the aerosol sulfate was in the accumulation mode (modal radius r 0.1 micron) and that 90% of total sulfate originated southwest of the Whiteface Mountain site. During a typical pollution episode originating in the Midwest, the total aerosol sulfate concentration was 19 microgram/cu m, or 63% of total dry aerosol, which was 30 microgram/cu m. Scavenging of sulfate aerosol by clouds was found to be greater than 95% efficient in clouds of 0.5 gram/cu m liquid water content. Measured pH values when the air mass trajectories were from the southwest were systematically lower than when the trajectories were from the northwest or northeast, i.e., 3.4 vs 4.4 and 4.8. In the southwest sector water samples, SO4(-2) and NO3(-) were highly correlated to each other and to free H(+), Ca2(-), Pb, and Ba. (Author's abstract)
W88-07596

TRANSIENT ACID SURGES IN AN UPLAND STREAM,
Institute of Hydrology, Wallingford (England).
E. M. Morris, and A. G. Thomas.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 4, p 429-438, August 1987. 3 fig, 5 ref.

Descriptors: *Acid rain, *Acid surges, *Model studies, *Path of pollutants, *Catchment areas, Hydrology, Water chemistry, Water pollution sources, Water quality, Mathematical studies, Scotland, Acidity, Snow melt, Seasonal variation.

The hydrological and chemical processes controlling transient acid surges in a small, upland catchment in the Cairngorm Mountains of Scotland were examined. The major episodes of increased acidity were produced by preferential elution of pollutants from snow at the onset of melt and by heavy autumn rainstorms when the catchment was saturated or frozen. Records of flow and water quality over a 3 yr period have been used to calibrate a lumped conceptual hydrochemical model. Using this model it is shown that concentration and distribution of input pollution by hydrological processes is the major control on episodic variations of stream water quality in this catchment. (Author's abstract)
W88-07598

PEATLAND WATER CHEMISTRY IN CENTRAL ONTARIO IN RELATION TO ACID DEPOSITION,
Canadian Wildlife Service, Ottawa (Ontario).
P. J. Blancher, and D. K. McNicol.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 217-232, October 1987. 4 fig, 4 tab, 49 ref.

Descriptors: *Acid rain, *Peatbags, *Ontario, *Water chemistry, *Water pollution sources, Minerals, Hydrogen ion concentration, Organic carbon, Ions, Acidity, Fens, Sulfates, Nickel, Copper, Manganese, Ontario.

Thirty-one peatlands from two areas of central Ontario were sampled to assess the influence of acid deposition on peatland water chemistry. Factor analysis differentiated peatland water chemistry along three major axes of chemical variation, interpreted as axes of organic concentration, mineral concentration, and deposition influence. Water from the surface mats had a higher organic concentration than water from open pools. Mineral influence in peatland waters was reflected by higher concentrations of Ca, Mg, Na, and silica in fen pools compared to bog pools. The influence of high acid deposition in the Wanapitei study area was indicated by high concentrations of sulfate, Ni, Mn, and Cu, and lower pH compared to an area that has received less acidic deposition (Ranger). Regression analyses indicated that H(+) variation in bogs could be largely explained by organic C concentration, but that sulfate concentration was also positively associated with acidity, while Ca was negatively associated with acidity. (Author's abstract)
W88-07599

IN SITU COMPARTMENTATION AND BIOMAGNIFICATION OF CHROMIUM AND MANGANESE IN INDUSTRIALLY POLLUTED HUSAINSAGAR LAKE, HYDERABAD, INDIA,
Dept. of Microbiology, Osmania Univ., Hyderabad, 500 007, India.
G. Seenayya, and A. K. Prahalad.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 233-239, October 1987. 1 fig, 2 tab, 33 ref. University Grants Commission, New Delhi, India No. 1432/82 (SR-II).

Descriptors: *India, *Population exposure, *Bioaccumulation, *Heavy metals, *Path of pollutants, *Chromium, *Manganese, *Husainsagar Lake, Food chains, Phytoplankton, Fish, Lakes, Sediments.

The concentrations of Cr and Mn in water, sediment, nanoplankton, phytoplankton, and fish were determined during 1983-1984, to investigate biomagnification of these metals in Husainsagar Lake, India. The concentration of Cr in the water phase was above the permissible limits and Mn exhibited a complex distribution pattern. The high concentrations of Cr and Mn in the surficial sediment was related to an increase in the intensity of in situ processes, mainly the enrichments of these metals in the organisms. The concentration of Cr was least in nanoplankton, and remained the lowest in samples of phytoplankton, zooplankton and fish. The concentration of Mn decreased from nanoplankton to fish, except in phytoplankton which showed the highest concentration. This trend did not illustrate the expected pattern of food chain enrichment in the classic sense of the term as noted for Hg and DDT. Furthermore, the Mn, but not the Cr, concentrations decreased with the increase in body weight of the fish. (Author's abstract)
W88-07600

TRACE METALS IN FISH EXPOSED TO ASBESTOS RICH SEDIMENTS,
British Columbia Univ., Vancouver. Westwater Research Centre.
H. Schreier, T. G. Northcote, and K. Hall.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 279-291, October 1987. 4 fig, 4 tab, 44 ref.

Descriptors: *Nickel, *Chromium, *Cobalt, *Manganese, *Path of pollutants, *Water pollution effects, *Fish, *Asbestos, *Sediments, *Sumas River, Population exposure, Landslides, Hydrogen ion concentration, Heavy metals, Tissue analysis, Trace metals.

Chrysotile asbestos fibers which contain high levels of Ni, Cr, Co, and Mn were introduced into the Sumas River in Washington state by a landslide. The pH in the streamwater decreased with increasing distance from the landslide input source and in the process the trace metals in the asbestos rich sediments get leached. The findings show that some of the trace metals such as Mn and Ni are elevated in several fish species. The Mn levels in fish muscle tissue and whole fish were significantly higher than levels reported in the literature. Similarly Ni levels in whole fish were high. Threespine stickleback had the highest Mn and Ni levels. Besides the elevated metal levels, no other abnormalities in fishes of the system were observed. (Author's abstract)
W88-07603

CHEMICAL COMPOSITION OF HOARFROST, RIME AND SNOW DURING A WINTER INVERSION IN UTAH, U.S.A.,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
T. E. Cerling, and A. J. Alexander.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 373-379, October 1987. 1 fig, 2 tab, 17 ref.

Descriptors: *Acid rain, *Water pollution sources, *Path of pollutants, *Hoar frost, *Rime, *Snow, *Utah, Water chemistry, Deposition, Ions.

Data on the chemical composition of hoarfrost, rime, and snow grains that accumulated during an eighteen-day long temperature inversion event in Salt Lake City, Utah in December 1985 and January 1986 are presented. Chemical analyses showed that the precipitation formed during this inversion event was acidic (as low as pH 3.85) and had nitrate and sulfate contents up to 1680 and 1290 micro-eq/L, respectively. Ammonia, nitrate, and sulfate deposition of 361, 615, and 792 micro-eq/sq m, respectively, occurred in a six-day period due to the accumulation of snow grains during this inversion. (Author's abstract)
W88-07605

TRANSPORT OF POLYCHLORINATED BIPHENYLS (PCBS) IN FRESHWATER MESOCOSMS FROM SEDIMENT TO WATER AND AIR,
Lund Univ. (Sweden). Dept. of Ecology.
P. Larsson, and A. Sodergren.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 33-46, November 1987. 5 fig, 4 tab, 44 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Sediment-water interfaces, *Seasonal variation, Lipids, *Mesocosms, *Sediments, Temperature effects, Aquatic habitats, Fish, Air-water interfaces.

With sediment as a source the flux of PCBs to water and air was followed in mesocosms with and without fish for two vegetation seasons. The fish represented the largest lipid pool in the mesocosm, and their presence increased the flux of PCBs across the sediment/water interface. The flow of PCBs from sediment to water followed a seasonal pattern with higher rates during summer than in the winter. The rates were governed by the turbation activity of benthic invertebrates, the extent of gas production in the sediment, the amount and quality of the lipid pools in the water column, and the solubility of the PCBs. The greatest amount of PCBs among the lipid pools was found in the dissolved extractable lipids, which also showed the highest concentration of PCBs calculated on a lipid basis. After about 1.5 yr, > 90% of the PCBs added was still in the sediment. The remainder was distributed within the mesocosms to various extents depending on the amount and quality of the lipid pools, or transferred into the air. Transfer into the air was governed by PCB concentrations in the water, and by water temperature. The flow was highest during summer, when the surface microlayer renewed its load of PCBs every 8th day. (Author's abstract)
W88-07608

REGIONAL PATTERNS OF SULFUR RETENTION IN WATERSHEDS OF THE EASTERN U.S.,
Northrop Services, Inc., Corvallis, OR.

For primary bibliographic entry see Field 2K.
W88-07609

COMPOSITION OF ACIDIC MELTWATERS DURING SNOWMELT IN THE SCOTTISH HIGHLANDS,

Dept. of Oceanography, The Univ., Southampton S09 5NH, U.K.
M. Tranter, T. D. Davies, P. Brimblecombe, and C. E. Vincent.

Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 75-90, November 1987. 10 fig, 2 tab, 24 ref. NERC Grant No. GR3/5144A and EEC Grant No. ENV/782/UK.

Descriptors: *Snowmelt, *Acidic water, *Water chemistry, *Model studies, *Acidrain, *Acid precipitation, *Water pollution sources, *Path of pollutants, *Scotland, Solutes, Snow, Ice, Ablation, Hydrogen ion concentration, Mathematical studies, Sulfates, Nitrates, Snowpack.

The chemical composition of meltwaters collected within a remote snowpack in the Scottish Highlands was modeled by the mixing of two components. The first component is concentrated and may originate from the solute-rich waters held at the crystal surfaces, whereas the second is dilute and possibly originates from the melting of the solute-poor interiors of snow and ice crystals. The proportional ionic composition of the components differ. In general, meltwaters become more dilute as ablation proceeds, and solutes near to the surface of the snowpack are rapidly leached. Meltwaters do not necessarily become more concentrated as they percolate through the snowpack. Snowpack hydrology is likely to be a major control on the depth-concentration relationship. The composition of meltwaters from deeper within the snowpack provides some evidence for the preferential elution of acidic solutes (H(+), SO4(2-), and NO3(-)) with respect to sea salt (Na(+) and Cl(-)). However, changes in the ionic concentration of these meltwaters, which are already proportionally enriched in sea salt, brought about by preferential elution are small compared to changes in concentration as a result of two component mixing or dilution. (Author's abstract)
W88-07610

SIMULATED ACID RAIN AND THE IMPORTANCE OF ORGANIC LIGANDS ON THE AVAILABILITY OF ALUMINUM IN SOIL,

Cooperative Inst. for Research in Environmental Science, Boulder, CO.
S. C. Tam.

Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 193-206, November 1987. 5 fig, 4 tab, 33 ref.

Descriptors: *Water pollution sources, *Soil properties, *Acid rain, *Simulated rainfall, *Path of pollutants, *Aluminum, *Organic ligands, Soil profiles, Ion exchange.

Equilibrium extracts from soils of different horizons at a single profile were examined. The Al species in the extracts were characterized with oxine and chelex-100 exchange techniques. The amount of Al depended strongly on the availability of organic ligands, especially the more strongly-binding ones, in the soil. The reaction to an acidic input to the soil was also controlled by the amount and the nature of the organic ligands. (Author's abstract)
W88-07615

ACIDIFICATION TRENDS IN SWEDEN,

Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
P. Sanden, A. Grimvall, and U. Lohm.

Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 3/4, p 259-270, December 1987. 3 fig, 7 tab, 15 ref.

Descriptors: *Sweden, *Path of pollutants, *Water pollution sources, *Regional analysis, *Acid rain, *Water quality, *Sulfur compounds, *Catchment areas, Hydrology, Water chemistry, Deposition, Surface water, Rainfall.

A Swedish hydrochemical monitoring program, which was started during the International Hydrological Decade (1965-1975), has been evaluated with respect to trends and regional differences in acidic deposition and stream water quality. Despite the more than twofold decrease in S emissions in Sweden since the early 1970's, there was only a marginal decrease in sulfate level in precipitation, indicating that long-range transport dominates precipitation chemistry. Trend analyses of stream water data gave practically no evidence that surface water quality had been changing since the late 1960's, i.e., no time lagged or accumulating effects of acidic deposition during past decades could be demonstrated. The difference between the wet deposition of S in southern and northern parts of Sweden was smaller than previously reported. In the northern catchment areas, the input of S was considerably larger than the output. The statistical uncertainty of the trend estimates raises questions about the effectivity of present hydrochemical monitoring programs in detecting environmental changes. (Author's abstract)
W88-07617

TRACE METALS IN PRECIPITATION IN SWEDEN,

Dept. of Meteorology, Univ. of Stockholm, S-106 91 Stockholm, Sweden.
H. B. Ross.

Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 3/4, p 349-363, December 1987. 6 fig, 7 tab, 25 ref. NFR Contract G-GU 3922-111.

Descriptors: *Rainfall, *Sweden, *Trace metals, *Heavy metals, *Path of pollutants, *Water pollution sources, *Acid rain, Spatial distribution, Regional analysis, Metals, Cadmium, Copper, Iron, Lead, Zinc, Manganese.

Trace metal (Cd, Cu, Fe, Mn, Pb, and Zn) concentrations in atmospheric precipitation have been routinely monitored in Sweden since the autumn of 1983. Concentrations are highest in southern Sweden and decrease northward. It is postulated that the long range transport of anthropogenic pollutants from the rest of Europe is the major source of Cd, Pb, and Zn in precipitation. Evidence for this hypothesis is that enrichment factors indicate anthropogenic origin, and Swedish atmospheric emissions of Zn and Cd are 2 to 3 times smaller than deposition fluxes. Also, Cd, Pb, and Zn concentrations are correlated in both space and time and are also well correlated with exSO4(2-) (sulfate minus sea salt component), a substance known to be of anthropogenic origin transported long distances. (Author's abstract)
W88-07619

OVERVIEW OF IMMISCIBLE FINGERING IN POROUS MEDIA,

Waterloo Univ. (Ontario). Inst. for Ground Water Research.
B. H. Kueper, and E. O. Frind.

Journal of Contaminant Hydrology, Vol. 2, No. 2, p 95-110, March 1988. 4 fig, 2 tab, 55 ref.

Descriptors: *Immiscible fingering, *Groundwater movement, *Porous media, *Geohydrology, *Path of pollutants, *Fluid mechanics, Model studies, Mathematical models, Random walk models, Simulation, Mathematical studies, Hydrology, Percolation.

The theory governing the stability of immiscible displacements in porous media is reviewed with the specific needs of contaminant hydrogeologists in mind. Criteria to determine whether or not displacements occurring in homogeneous porous media will bring about fingered fluid distributions are first addressed. These criteria are a function of the density, viscosity, and surface tension of the fluids involved. Immiscible displacements occurring in natural porous media are next reviewed with an emphasis on porous media heterogeneity. It is concluded that natural porous media contain heterogeneities at a fine enough scale such that no distinction need be made between stable and unstable displacements. The limitations associated with the use of the conventional multiphase flow equations in simulating immiscible fingering are examined. The use of random walk models and percolation theory to describe immiscible fingering is also reviewed. (Author's abstract)
W88-07621

CHARACTERIZING THE UNCERTAINTY OF PESTICIDE LEACHING IN AGRICULTURAL SOILS,

Environmental Research Lab., U. S. Environmental Protection Agency, Athens, GA 30613, U.S.A.
R. F. Carsel, R. S. Parrish, R. L. Jones, J. L. Hansen, and R. L. Lamb.

Journal of Contaminant Hydrology, Vol. 2, No. 2, p 111-124, March 1988. 5 fig, 7 tab, 31 ref.

Descriptors: *Leachates, *Path of pollutants, *Regional analysis, *Model studies, *Simulation, *Aldicarb, *Pesticides, *Corn, Field capacity, Hydrology, Mathematical studies, Soil water, Monte Carlo method, Climates, Pesticide Root Zone Model, Stochastic process, Rainfall, Ohio.

A Monte-Carlo numerical simulation procedure for making regional assessments of pesticide leaching has been developed. This procedure uses probability density functions for organic matter, field capacity, and wilting point developed from information on approximately 3000 soils. Variations in climatic conditions were incorporated by random selection of yearly rainfall data. The procedure was demonstrated for aldicarb applied to corn grown in Ohio. A total of 2000 parameter sets were evaluated using the unsaturated zone model PRZM. The simulation results indicated that convergence of the 90th, 95th, and 99th percentiles for movement past 0.3, 0.6, 0.9, and 1.5 m was obtained after 500 simulations. The relative uncertainty associated with these percentiles was approximately 50% after 1500 simulations. The downward movement of aldicarb residues was most sensitive to changes in field capacity. These simulations, coupled with additional soil-specific simulations, indicated no significant movement of aldicarb residues beyond 1.8 m for applications to Ohio corn. (See also W88-07623) (Author's abstract)
W88-07622

SIMULATION PROCEDURE FOR GROUNDWATER QUALITY ASSESSMENTS OF PESTICIDES,

Environmental Research Lab., U. S. Environmental Protection Agency, Athens, GA 30613, U.S.A.
R. F. Carsel, R. L. Jones, J. L. Hansen, R. L. Lamb, and M. P. Anderson.

Journal of Contaminant Hydrology, Vol. 2, No. 2, p 125-138, March 1988. 1 fig, 9 tab, 24 ref.

Descriptors: *Path of pollutants, *Regional analysis, *Solute transport, *Model studies, *Simulation, *Leachates, *Groundwater pollution, *Aldicarb, *Pesticides, *Peanuts, Stochastic process, Hydrology, Mathematical studies, Soil water, North Carolina, Monte Carlo method, Pesticide Root Zone Model, Prediction, Saturation zone, Aeration zone.

A procedure is described for making regional assessments of pesticide residue loadings and movement in groundwater and downgradient from treated fields. A Monte-Carlo numerical simulation technique is used to generate model parameters for both the unsaturated and saturated zones. Simulations are performed using the Pesticide Root Zone Model linked to a simple groundwater solute transport model. The procedure is useful for evaluating the potential for producing pesticide residues in drinking water wells before actual field applications are made. Appropriate land management options, including restrictions on pesticide application, also can be developed using this procedure. The procedure was used to assess aldicarb levels in northeastern North Carolina groundwater resulting from application of the pesticide to peanuts. Probability density functions for selected soil characteristics were developed using a direct-access soils information data base. Probability density functions for selected groundwater characteristics were developed from available data for the study area. Simulation results indicated that mass fluxes to groundwater exceeded 0.01 and 0.1 kg/ha ap-

proximately 6.9 and 1.0 percent of the time, respectively. No fluxes exceeded 0.1 kg/ha at a distance of 60 m downgradient in any of the cases evaluated. (See also W88-07622) (Author's abstract)
W88-07623

GROUNDWATER MUNITION RESIDUES AND NITRATE NEAR GRAND ISLAND, NEBRASKA, U.S.A.,
Nebraska Univ., Lincoln. Conservation and Survey Div.
R. F. Spalding, and J. W. Fulton.
Journal of Contaminant Hydrology, Vol. 2, No. 2, p 139-153, March 1988. 9 fig, 26 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Groundwater pollution, *Explosives, *Groundwater plumes, Cyclotrimethylene trinitramine, Trinitrotoluenes, Transport, Velocity, Nitrate, Soil water, Nitrogen isotopes, Hydrology, Isotope studies, Animal wastes, Darcys Law.

Munition residues from waste disposal on ordnance property have resulted in a defined plume of cyclotrimethylene trinitramine (RDX) contaminated groundwater stretching 6.5 km and underlying an area of 6.5 sq km. A smaller plume of 2,4,6-trinitrotoluene (TNT) was detected near the plant's boundary. The relative positions of the plumes combined with an historical review of total plant output of RDX and TNT indicates that RDX is much more persistent than TNT. The estimated RDX transport velocity of 0.5 m/day closely approximates the calculated Darcian velocity. The RDX plume sinks with recharge at a rate of about 0.5 m/yr. Nitrate is associated primarily with adjacent upgradient land use and is not related to plant manufacture of ammonium nitrate. The average nitrogen isotope composition of the nitrate was about + 10 parts per thousand and strongly suggests that animal wastes are the predominant source. (Author's abstract)
W88-07624

TRANSFORMATIONS OF TRACE HALOGENATED ALIPHATICS IN ANOXIC BIOFILM COLUMNS,
Geography and Environmental Engineering, The Johns Hopkins Univ., Baltimore, MD 21218, U.S.A.
E. J. Bouwer, and J. P. Wright.
Journal of Contaminant Hydrology, Vol. 2, No. 2, p 155-169, March 1988. 10 tab, 33 ref. EPA Grant No. EPA-R-811345010.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Biodegradation, *Trihalomethanes, *Chlorinated hydrocarbons, *Nitrification, *Biofilm columns, *Anoxia, *Microbial degradation, Hydrology, Microbiological studies, Mineralization, Transformation, Carbon tetrachloride, Sulfates. Methanogenesis, Metabolism.

The transformability of trihalomethanes, carbon tetrachloride, 1,1,1-trichloroethane, 1,2-dibromoethane, tetrachloroethylene, hexachloroethane, and dibromochloropropane was studied under conditions of denitrification, sulfate respiration, and methanogenesis. These compounds at concentrations commonly found in groundwater were continuously administered to anoxic biofilm columns that resembled groundwater environments. Acetate was the primary substrate to support microbial growth. All of the compounds studied were transformed under methanogenesis. Bromoform, bromodichloromethane, carbon tetrachloride, and hexachloroethane were transformed even under the less reducing conditions of denitrification. Some of the compounds were partially mineralized to CO2. However, reductive dehalogenation appeared to be the predominant mechanism for removal. Characterization of the available electron acceptors in the subsurface is important for assessing organic micropollutant biotransformation. Reaction rates observed in the laboratory biofilms indicate that biotransformation could be responsible for significant removals of these halogenated compounds in the subsurface. (Author's abstract)
W88-07625

PERSISTENCE AND TRANSPORT OF BACTERIA AND VIRUSES IN GROUNDWATER - A CONCEPTUAL EVALUATION,
Inst. of Geology and Paleontology, Kiel, F. R. Germany.
G. Matthess, A. Pekdeger, and J. Schroeter.
Journal of Contaminant Hydrology, Vol. 2, No. 2, p 171-188, March 1988. 5 fig, 3 tab, 60 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Aquifers, *Groundwater pollution, *Model studies, *Pathogens, *Filtration, *Bacteria, *Viruses, Advection, Dispersion, Microorganisms, Hydrology, Microbiological studies, Mathematical studies, Literature review, Transport, Mathematical models.

The results of an interdisciplinary research program of literature review and laboratory studies on the subsurface persistence and transport of pathogenic bacteria and viruses are evaluated on the basis of an expanded advection-dispersion model which considers the persistence of these microorganisms under the conditions found within an aquifer, the retardation by adsorption-desorption processes and the role of filtration processes. The model indicates that the principal controls are filtration processes, the microorganisms being fixed on the filter media are ultimately eliminated or inactivated by biological, chemical and physical processes. (Author's abstract)
W88-07626

RAINDROPS, AIR POLLUTION AND BURSTING BUBBLES,
Ecole Nationale Superieure de Techniques Avancees, Paris (France).
G. M. Afeti.
Weather WTHRAL, Vol. 42, No. 11, p 338-341, November, 1987. 3 fig, 2 ref.

Descriptors: *Rain, *Air pollution, *Bubbles, *Fluid mechanics, *Path of pollutants, Weather, Lasers.

Laser holography was used to study the bursting of bubbles, with particular attention to the breaking of the hemispherical dome into 'film-drops.' It was determined that film-drops are the end product of a chain of events, lasting a total of about 300 microseconds, beginning with the formation of a number of liquid filaments. This sequence of action reinforces the 'capillary-wave theory' of bubble film cap rupture, with rupture preceded by thinning of the film through a process of liquid drainage from the top of the bubble down to its base. The flow follows a wavelike path with crests and valleys. Several perforations may occur in the thinner parts of the film almost simultaneously, turning the collapsing bubble dome into a network of liquid filaments. The larger the bubble, the greater the number of film-drops produced. The smallest drop detected was about 6 microns. (Doria-PTT)
W88-07645

BACTERIOLOGICAL QUALITY OF BOTTLED NATURAL MINERAL WATERS,
Public Health Laboratory, University Hospital of Wales, Heath Park, Cardiff CF4 4XW, Wales.
For primary bibliographic entry see Field 5A.
W88-07668

RAPID STATISTICAL CORRELATION BETWEEN POLLUTION SOURCES AND MARINE CONCENTRATIONS,
Institute of Oceanography, Bulgarian Academy of Sciences, 9000 Varna, Bulgaria.
For primary bibliographic entry see Field 5A.
W88-07697

DISTRIBUTION OF MERCURY IN THE OPEN-SEA REGION OF THE SOUTH-WESTERN BLACK SEA,
Institute of Oceanography, Bulgarian Academy of Sciences, 9000 Varna, Bulgaria.
G. Andreev.
Toxicological and Environmental Chemistry TXECBP, Vol. 16, No. 1, p 75-80, 1987. 3 fig, 13 ref.

Descriptors: *Mercury, *Fate of pollutants, *Path of pollutants, Water pollution, Black Sea, Chemocline, Spatial distribution, Heavy metals, Distribution graphs, Distribution patterns, Atomic absorption spectrophotometry, Vertical distribution, Sulfides.

A total of 65 samples collected from 14 stations located in the south-west portion of the Black Sea were analyzed for mercury by electrothermal atomic absorption spectroscopy. The mercury concentrations in the region varied between 0.1-1.1 micrograms (ug)/cu dm for surface waters, 0.15-0.74 ug/cu dm for the intermediate water layer, and 0.06-0.61 ug/cu dm for the bottom layer. Spatial distribution graphs for the sampling locations are presented for the three water layers. A minimum of mercury is observed in the north-south direction for the stations closest to the coast for all three water layers; a similar situation exists for the intermediate group of stations in the surface and intermediate water layers. No mercury minimum is observed in the stations furthest from the coast. The concentration of mercury in the hydrogen sulfide layer typically found in the Black Sea decreases in deep water sampling stations. It is suggested that the decrease is a result of the natural process of mercury migration from the water phase through the suspended phase to the bottom precipitates. The formation of insoluble mercury(II) sulfide removes the mercury from the water system. (Wood-PTT)
W88-07698

RELATIONSHIP OF GULLY SIDEWALL SHAPE TO SEDIMENT PRODUCTION,
Soil Conservation Service, Gunnedah (Australia).
For primary bibliographic entry see Field 2J.
W88-07703

ACID RAIN IN NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
C. Samara, C. Balafoutis, and T. Kouimtzis.
Toxicology and Environmental Chemistry TXECBP, Vol. 16, No. 2, p 111-118, 1988. 7 fig, 12 ref.

Descriptors: *Dioxins, *Acid rain, *Hydrogen ion concentration, *Weather patterns, Water pollution sources, *Conductivity, Greece, Air masses, Air pollution, Precipitation, Rainfall, France, Spain, Europe.

Conductivity and pH were measured for 90% of the precipitation events in Thessaloniki (Northern Greece) from October 1984 until April 1987. Large pH variations ranging from 4.20 to 8.35 were recorded. In 25% of the cases the precipitation exhibited a pH < 5.0. In most cases the conductivity was between 10 and 20 uS/cm, although some alkaline precipitation with relatively high conductivity (up to 500 uS/cm) was also observed. Air mass trajectories based on 500 mB weather charts were graphically constructed in order to explain the pH and conductivity data. The charts showed that in most cases, the precipitation events were caused by depressions (lows) in the gulf of Genova or above the Northern Sahara which are characterized by winds coming from SSW or W of Greece. Of the precipitation, 48% was caused by air masses coming from Southern France or Northern Spain and were characterized by pH close to that of clean rain and relatively low conductivity. Air masses originating in Southern Greece (Northern Sahara) accounted for 28% of the precipitation and produced precipitation with a pH > 6.5 and high conductivity. The other 24% of the precipitation events, characterized by a pH of 4.5-5.1, are caused by air masses from Northern and NW-Greece originating in Northern and Central Europe. (Wood-PTT)
W88-07708

DISTRIBUTION AND MOBILITY OF ORGANIC AND INORGANIC MERCURY IN FLOUNDER, PLATICHTHYS FLESUS, FROM A CHRONICALLY POLLUTED AREA,
Institute of Biology, Odense University, Campus-

vej 55 DK-5230 Odense M, Denmark.
H. U. Riisgard, and P. B. Famme.
Toxicology and Environmental Chemistry TXECBP, Vol. 16, No. 3, p 219-228, 1988. 5 fig, 1 tab, 16 ref.

Descriptors: *Mercury, *Path of pollutants, *Fish, *Fish physiology, Food chains, Flounders, Heavy metals, Pollutants, Denmark, Liver, Muscle, Kidneys, Accumulation, Bioaccumulation, Methylmercuryj, Tissue analysis.

Flounders, Platichthys flesus, were caught in September 1985 in the Nissum Broad (Western Limfjord, Denmark), in an area chronically polluted with mercury discharged from a now demolished chemical factory 25-30 years ago and transferred to clean water. About 6% of the total mercury from the recently caught fish was inorganic in the muscle tissue, while about 50% was inorganic in the liver and kidney tissue. During 171 days in clean water no loss of mercury from the fillet-muscle could be seen with certainty, although a net uptake of mercury was observed in the liver after about 4 months. In the same period an increase in the mercury concentrations in the kidney tissue and blood cells was observed. A tentative interpretation of the findings is that both organic (presumably in the form of methylmercury) and inorganic mercury were immobilized within the muscles, from which the two mercury species were mobilized during the long period of starvation and transported via the blood to the liver and kidney, where they accumulated. (Wood-PTT)
W88-07709

EMPIRICAL RELATIONSHIPS BETWEEN LAND USE/COVER AND STREAM WATER QUALITY IN AND AGRICULTURAL WATERSHED,
Aquatic Biology Station, Illinois State Natural History Survey, 607 E. Peabody Drive, Champaign, IL 61820, USA.
L. L. Osborne, and M. J. Wiley.
Journal of Environmental Management JEVMAW, Vol 26, No. 1, p 9-27, January 1988. 5 fig, 4 tab, 20 ref.

Descriptors: *Water pollution sources, *Land use, *Water quality, *Nitrates, *Phosphorus, Agricultural watersheds, Salt Fork watershed, Illinois, Watershed management, Planning, Watersheds, Regression analysis, Urbanization.

The empirical relationships that existed between land use/cover patterns within the Salt Fork watershed, Illinois, and instream nitrate-N and soluble phosphorus were examined in order to provide information to help in the formulation of watershed-level planning and management practices and methodologies. Aerial photographs were interpreted and digitized using Arc/Info geographic information software and the land use/cover data related to the mean seasonal nitrate-N and soluble reactive phosphorus concentrations collected from 22 sampling stations in the Salt Fork watershed, using multiple regression analysis. The results indicate that urbanization, rather than agriculture, is the major factor controlling the soluble reactive phosphorus instream concentrations throughout the entire year, and was important in explaining the majority of the variance associated with nitrate-N during roughly 50% of the year. Application of the results and methodologies to planning and watershed management are discussed, as are the relationships of management of instream concentration vs. loading of exogenous substances. (Author's abstract)
W88-07711

WATER QUALITY AND BIOLOGICAL SURVEY OF THE WEST BRANCH SUSQUEHANNA RIVER,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Publication No. 92. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. January 1985. 35 p, 4 fig, 1 tab, 19 ref. EPA Grant No. I-003992-83-0.

Descriptors: *Water quality, *Biological surveys, *Pennsylvania, *Acid mine drainage, *Susquehanna River, *Bald Eagle Creek, Fish, Macroinvertebrates, Bioindicators, Alkalinity, Mine wastes, Surveys.

During the Summer of 1983, a water quality and biological survey (aquatic macroinvertebrates and fish) of the West Branch Susquehanna River was conducted. Over 100 miles of the West Branch and many more miles of tributaries are seriously degraded by acid mine drainage. The upper 75 miles of the West Branch have shown improvement over the last 20 years. The lower 75 miles have been restored to good water quality due to the large contribution of alkalinity from Bald Eagle Creek. Many tributaries not impacted by acid mind drainage have excellent water quality. Many streams degraded by acid mine drainage, including the West Branch, have the potential to return to good water quality, if sources of acid mine drainage are abated. (Author's abstract)
W88-07714

SUMMARY OF DATA FROM A TOXICS SCREENING SURVEY OF THE LOWER SUSQUEHANNA RIVER AND MAJOR TRIBUTARIES,
Susquehanna River Basin Commission, Harrisburg, PA.
C. S. Takita.
Publication No. 86. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. January 1984. 47 p, 1 fig, 3 tab, append. EPA Grant No. I-003992810.

Descriptors: *Path of pollutants, *Toxicity, *Susquehanna River, *Surveys, *Pennsylvania, *Maryland, *Pollutant identification, Heavy metals, Priority pollutants, Chromium, Copper, Lead, Nickel, Zinc, Herbicides, Insecticides, Water analysis.

The Susquehanna River Basin Commission (SRBC) cooperated with the Pennsylvania Department of Environmental Resources (Pa. DER) in conducting a toxics screening survey of the Susquehanna River and tributary streams between Duncannon, PA, and the Conowingo Dam in Maryland. Based on the samples collected for this survey, the quality of the waters of the Lower Susquehanna River and its tributaries is very good with respect to heavy metals and organic contaminants. Chromium, copper, lead, nickel, and zinc were found at all sampling sites, but were within acceptable levels. All of the other metals detected were also within acceptable limits. Two herbicides and four insecticides were detected at various sampling sites, but they were well below the maximum allowable toxicant concentrations. Priority pollutants were detected at sampling sites on Paxton Creek and Codorus Creek only. These streams flow through urban and industrial areas and were considered to be the likely streams to show measureable quantities of organics. With exception of phenol, the concentrations of priority pollutants found were below the maximum allowable toxicant concentrations. Additional samplings of Paxton Creek and Codorus Creek should be made to better evaluate the prevalence and levels of the constituents. Although attempts were made to collect water samples after periods of significant rainfall as well as during base flow, the sampling period was drier than normal. Additional sampling may be necessary to determine whether overland runoff during a period of normal rainfall has a significant effect on instream concentrations of heavy metals, pesticides and priority pollutants. (Lantz-PTT)
W88-07718

WATER QUALITY AND BIOLOGICAL SURVEY OF THE SUSQUEHANNA RIVER BASIN FROM WAVERLY, NEW YORK TO SUNBURY, PENNSYLVANIA,
Susquehanna River Basin Commission, Harrisburg, PA.
B. R. Malione, C. P. McMorran, and S. E. Rudisill.
Publication No. 89. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. July 1984. 290 p, 31 fig, 8 tab, 31 ref, 5 append. EPA Grant No. I-003992-83-0.

Descriptors: *Water quality, *Surveys, *Biological surveys, *Susquehanna River, *New York, *Pennsylvania, *Water pollution sources, Susquehanna River basin, Acidic waters, Water quality, Alkalinity, Dissolved solids, Industrial wastes, Acid mine drainage, Data collections, Storm runoff Macroinvertebrates, Fish.

A water quality and biological survey of the Susquehanna River and its tributaries between Waverly, New York and Sunbury, Pennsylvania was conducted during July and August, 1982. The overall quality of each river and tributary station was assessed on the basis of water quality, macroinvertebrate, and fish data. The general quality of the river and tributaries in the study area is characterized. The reach of the Susquehanna River from Waverly, NY (river mile (RM) 290) to the mouth of the Lackawanna River (RM 197) has very good water quality and supports a healthy biological community. Most of the tributaries between Waverly and the mouth of the Lackawanna River flow through agricultural and forested land. The headwaters of many of the west bank tributaries (such as Mehoopany and Bowmans Creek) are naturally acidic, and have low concentrations of alkalinity and dissolved solids. They are infertile and unproductive downstream to the lower reaches where runoff from agricultural land increases the streams' fertility. The overall quality of the reach from the mouth of the Lackawanna River (RM 197) downstream to Nanticoke (RM 181), known as the Wyoming Valley, is degraded by numerous sources of pollution. Drainage from abandoned coal mines causes the most obvious impact on water quality and is evident immediately downstream of the Lackawanna River where a red-orange precipitate coats the river channel along the left bank for several miles. In addition to mine drainage, most tributaries are degraded by storm water runoff and sewage; every stream had trash and other debris in its streambed. The overall quality of the reach from Nanticoke (RM 181) downstream to Sunbury (RM 125) is an improvement from that in the Wyoming Valley, but the river never regains the high quality it had upstream of the Wyoming Valley. Most of the tributaries in this reach contribute good quality water to the Susquehanna River. (Lantz-PTT)
W88-07719

WATER QUALITY AND BIOLOGICAL SURVEY OF THE JUNIATA RIVER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Publication No. 103. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. July 1986. 139 p, 6 fig, 11 tab, 19 ref, 2 append. EPA Grant No. I-003992-85-0.

Descriptors: *Water quality, *Juniata River, *Biological studies, *Path of pollutants, *Pennsylvania, Coliforms, Iron, Hydrogen ion concentration, Water pollution sources, Industrial wastes, Pulp and paper industry, Municipal wastes, Macroinvertebrates, Fish, Surveys, Data collections.

During July and August 1985, the Susquehanna River Basin Commission conducted a stream survey of the Juniata River subbasin. Forty-seven stations were sampled for water samples, field chemistry, macroinvertebrates and fish. Most of the streams in the subbasin were found to have good or excellent water quality depending upon the concentrations of iron and fecal coliform, the two most common pollutants. Iron, fecal coliform and pH were found to exceed water quality standards at several stations on the Juniata River, but do not appear to impair aquatic life. The Juniata River supports healthy biological communities and has good quality water throughout its length. A majority of the water pollution problems in the Juniata River Subbasin occur in the Little Juniata River and the Frankstown Branch Juniata River. The Little Juniata River has degraded water quality and biological conditions between Altoona and Tyrone due to municipal and industrial discharges. Water quality and biological conditions improve greatly downstream of Tyrone and the Little Juni-

ata River has good quality water at the confluence with Frankstown Branch Juniata River. The Frankstown Branch Juniata River suffers degradation from Halter Creek and Beaverdam Branch due to paper mill, other industrial and municipal discharges. Water quality improves downstream and is good from Clover Creek downstream to the confluence with the Little Juniata River. (Author's abstract)
W88-07720

WATER QUALITY AND BIOLOGICAL SURVEY OF THE CHEMUNG RIVER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Publication No. 99. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. October 1985. 91 p, 9 fig, 7 tab, 13 ref, 2 append. EPA Grant No. I-003992-85.

Descriptors: *Water quality, *Biological surveys, *New York, *Chemung River, *Tioga River, *Pennsylvania, *Water pollution sources, *Pollutant identification, Acid mine drainage, Public participation, Macroinvertebrates, Fish, Tropical storms, Behavior, Sedimentation, Data collections, Surveys, Organic compounds, Alkalinity, Path of pollutants.

During August 1984, the Susquehanna River Basin Commission conducted a stream survey of the Chemung River Subbasin (New York - Pennsylvania). Thirty-five stations were sampled for field chemistry, macroinvertebrates and fish. Water samples were collected at 14 of these stations for laboratory analyses. The most serious water quality degradation occurs in the Tioga River between Blossburg, PA and Tioga, PA. This reach is severely degraded by acid mine drainage. The Tioga-Hammond dams at Tioga serve to improve water quality in the lower reach of the Tioga River. Compared to historical data, water quality between Tioga and Painted Post, NY is much improved. The Canisteo River appeared to suffer water quality degradation in its upper reaches near Hornell, NY. Degradation due to sedimentation and organic pollution was indicated. Water quality improved as the river flowed downstream and the quality was good from the midpoint of the Canisteo River to its confluence with the Tioga River. The Cohocton River is an alkaline, productive river. Biological densities were high but no pollution stress was apparent. The Cohocton River and its tributaries have good to excellent water quality. The Chemung River has good water quality for most of its length. Degradation was observed downstream of Elmira, NY. Newtown Creek was severely degraded by sewage and contributes to this degradation. This degradation may cross the Pennsylvania state line, but by the time the Chemung River reaches its confluence with the Susquehanna River, it has recovered and has good water quality. (Author's abstract)
W88-07722

WATER QUALITY AND BIOLOGICAL SURVEY OF THE EASTERN HEADWATER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Publication No. 100. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. November 1985. 243 p, 17 fig, 8 tab, 1 plate, 15 ref, 2 append. EPA Grant No. I-003992-84-0.

Descriptors: *Water quality, *Biological surveys, *Susquehanna River, *Pennsylvania, *New York, Bioindicators, Macroinvertebrates, Data collections, Fish, Headwaters, New York, Coliforms, Dissolved oxygen, Water pollution effects, Water pollution sources, Surveys, Stress, Bacteria.

A stream survey was conducted of the Eastern Headwaters Subbasin of the Susquehanna River Basin during July and August, 1984. This Subbasin includes the area drained by the Susquehanna River upstream of its confluence with the Chemung River. A total of 72 stations were sampled in order to assess water quality and macroinvertebrate and fish communities. Water quality was generally good throughout the Subbasin. Many streams, including portions of the Susquehanna River, were excellent water quality. Fecal coliform concentrations were found to be excessive at several locations. However, other chemical parameters had low concentrations and overall water quality degradation was not observed. Concentrations of most chemical parameters were found to increase in the Susquehanna River downstream of Binghamton, New York. These were attributed to the numerous municipal and industrial discharges in this reach of river. Interstate streams were found to be of high quality and generally did not present any interstate problems relating to water quality. One stream, Snake Creek, was found to have low concentrations of dissolved oxygen. Concentrations were above minimum standards but this situation could be an indication of another problem which could lead to interstate water quality violations. Biological conditions were found to be of high quality throughout the Subbasin. Biological communities were healthy at all stations and did not show signs of pollution caused stress. (Author's abstract)
W88-07723

WATER QUALITY AND BIOLOGICAL SURVEY OF THE LOWER SUSQUEHANNA SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Publication No. 104. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. October 1986. 240 p, 15 fig, 13 tab, 22 ref, 2 append. EPA Grant No. I-003992-85-0.

Descriptors: *Water quality, *Biological surveys, *New York, *Pennsylvania, *Susquehanna River, *Water pollution sources, *Water pollution effects, Pollutant identification, Coliforms, Iron, Acid mine drainage, Metals, Acidic waters, Data collections, Surveys, Macroinvertebrates, Fish.

During the summer of 1985, a water quality and biological survey of the Lower Susquehanna Subbasin was conducted. Water quality in the Susquehanna River between Sunbury, Pennsylvania and Havre de Grace, Maryland is good. Fecal coliform is the most common parameter which fails to meet water quality standards (seven out of eleven stations). Iron also exceeds standards at several stations. All other parameters are within acceptable limits. Most of the tributaries to the Susquehanna River have good or excellent water quality. Fecal coliform is the most common parameter exceeding water quality standards (at 815 of stations sampled). Iron is next, exceeding standards at 61% of the stations sampled. Impacts of these pollutants are minor; most stations support health fish and aquatic insect communities. Several streams are seriously degraded by acid mine drainage. Shamokin Creek, Mahanoy Creek and Swatara Creek originate in the anthracite coal regions of Columbia, Northumberland and Schuylkill counties, Pennsylvania. These streams are characterized by low pH and alkalinity, and high concentrations of acidity and dissolved metals. Aquatic life is absent or severely reduced. Swatara Creek recovers as it flows downstream and attains good water quality throughout its lower reaches. Shamokin Creek and Mahanoy Creek are polluted for their entire lengths. Another severely degraded stream is Paxton Creek. Although its upper reaches are of good quality, the lower five miles flow through the city of Harrisburg and receive discharges of raw sewage and urban runoff. Fish and aquatic insects are absent and water quality is very poor. (Lantz-PTT)
W88-07724

SUMMARY OF WATER QUALITY DATA FROM THE CHEMUNG AND SUSQUEHANNA RIVERS NEAR THE NEW YORK - PENNSYLVANIA STATELINE,
Susquehanna River Basin Commission, Harrisburg, PA.
C. S. Takita.
Publication No. 74. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. December 1981. 11 p, 1 fig, 7 tab. EPA Grant No. I-003992810.

Descriptors: *Water quality, *Susquehanna River, *Water pollutant sources, *Coliforms, *Data collections, *Chemung River, *New York, *Pennsylvania, Errors, Storm runoff, Alkalinity, Organic compounds, Water analysis, Dissolved oxygen, Hydrogen ion concentration, Organic compounds, Temperature, Coliforms, Municipal wastewater.

The results of the water quality analyses (temperature, pH, dissolved oxygen, alkalinity, fecal coliforms, organic compounds) indicate that the quality of the waters in the Susquehanna and Chemung Rivers are good. Mean concentrations indicate that the quality of the water remains constant within the reach of the Susquehanna River sampled. However, the results of the analyses of individual samples show some fluctuation between sampling dates, indicating that existing municipal discharges do not have extensive impact on the quality of the Susquehanna River. A high fecal coliform result (2400 MPN/100 ml) in the Susquehanna River above Oakland on July 21, 1981 is believed to be an anomaly. A duplicate sample was not collected, however, the results of the other samples were low and field observations gave no reason to expect the high MPN. Runoff from rainfall occurring prior to sample collection on September 15, 1981 probably accounts for the high fecal coliform at all stations. (Lantz-PTT)
W88-07726

NUTRIENT MONITORING OF THE LOWER SUSQUEHANNA RIVER AND SELECTED TRIBUTARIES, OCTOBER 1, 1984 - SEPTEMBER 30, 1986: INTERIM REPORT,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 7A.
W88-07737

HYDROGEOLOGY OF THE OAK RIDGE GASEOUS DIFFUSION PLANT SITE,
Geraghty and Miller, Inc., Oak Ridge, TN.
For primary bibliographic entry see Field 2F.
W88-07742

DETAILED GEOLOGIC STUDIES ESTABLISH PERMEABILITY TRENDS FOR PLUME DEFINITION AND GROUND-WATER CLEAN-UP,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7A.
W88-07743

DISTRIBUTION OF DEGRADING CHLOROCARBON SOLVENTS IN WATER AND SOIL IN A CONTAMINANT PLUME,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
B. B. Looney, and I. W. Marine.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010163. Price codes: A03 in paper copy, A01 in microfiche. Report No. DP-MS--86-179, (1986). 29 p. DOE Contract No. DE-AC09-76SR00001.

Descriptors: *Chlorinated hydrocarbons, *Fate of pollutants, *Solvents, *Path of pollutants, *Degradation, *Soil contamination, *Groundwater pollution, Monitoring wells, Tetrachloroethylene, Organic compounds, Trichloroethylene, Dichloroethylene, Chemical reactions, Geohydrology.

Data from a plume of chlorinated organic solvents located beneath the metallurgical fabrication area (M Area) of the Savannah River Plant (SRP), is discussed. The plume in M Area has been studied in detail by a large number of individuals since 1982; these studies include: water samples from more than 200 monitoring wells; continuous split spoon sampling from more than 20 wells; and soil gas samples and other special samples. These samples were analyzed for their chlorocarbon constituents. The resulting data, combined with geologic

and hydrologic information, indicate that the transport and fate of these organics are influenced by degradation and sorption. The mass remaining in the plume and the ratio of constituents suggest that the degradation rates are ordered: Tetrachloroethylene (PCE) > or = Trichloroethylene (TCE); Dichloroethylene (DCE) >> PCE or TCE. Using a very simple first order decay rate assumption, the degradation of PCE under 'natural' conditions is on the order of 10%/yr (k = 0.1/yr). Further study is needed to determine if a coupling of sorption and degradation is occurring. (Lantz-PTT)
W88-07744

INFILTRATION AT YUCCA MOUNTAIN, NEVADA, TRACED BY CHLORINE-36,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 2F.
W88-07748

FOREST RESPONSES TO DEPOSITION OF AIR-BORNE CHEMICALS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Lab. for Air Pollution Impact to Agriculture and Forestry.
W. E. Winner, T. D. Leininger, and S. B. McLaughlin.
Available from the National Technical Information Service, Springfield, VA. 22161,as DE87-009824. Price codes: A02 in paper copy, A01 in microfiche. Report No. CONF-860123--1, (1986). 44 p, 1 fig, 1 tab, 92 ref. DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Water pollution sources, *Acid rain, *Air pollution effects, *Forests, Forestry, Nitrates, Sulfates, Ozone, Plant growth, Nitrogen, Sulfur, Trees.

The impact of air pollutants on forest growth and productivity are discussed with respect to (1) response of trees to gaseous pollutants; (2) evidence of growth declines from dendroecological studies; and (3) the response of forest canopies to the deposition of chemicals from the atmosphere. Evidence from air pollution fumigation experiments, dendroecology, and nutrient cycling studies indicates deposition of air-borne chemicals will likely affect tree growth over large regions. Points which still remain to be addressed include: (1) whether air pollution sensitive trees will be replaced by tolerant trees with no loss in forest productivity; (2) if seedlings are more resistant to air pollutants than large trees; and (3) factors which define whether deposition of atmospheric N and S results in growth stimulation or growth suppression. This study concludes that the: (1) ambient ozone can result in foliar injury and growth suppression; (2) dendroecological evidence demonstrates growth suppression for some species; (3) atmospheric deposition of H(+), SO4(2-), NO3(-), and other chemicals is increased by industrial sources of air pollution; (4) throughfall is depleted in NO3(-) and enriched in Ca and K relative to rainfall; and (5) commercial timber harvests are likely to be affected by H, S, and N deposition only in the long-term and only in some habitats. (Lantz-PTT)
W88-07749

DATA REPORT ON STATIC LEACH TESTS WITH SAVANNAH RIVER LABORATORY DEFENSE WASTE GLASS IN PBB1 BRINE AT 90 C,
Battelle Pacific Northwest Labs., Richland, WA.
B. P. McGrail, and V. L. Eliason.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011272. Price codes: A02 in paper copy, A01 in microfiche. Report No. PNL/SRP--6253, June 1987. 14 p, 2 tab. DOE Contract No. DE-AC06-76RL0 1830.

Descriptors: *Path of pollutants, *Leaching, *Savannah River Laboratory, *Radioactive waste disposal, *Waste disposal, *Georgia, *Brines, *Radionuclides, Glass, Groundwater movement, Model studies, Field tests.

The dissolution of glass waste forms in aqueous media is the only means by which encapsulated radionuclides become mobile and available for transport to the environment, discounting the unlikely potential for release by solid-state diffusion. Waste from dissolution studies assist the U.S. Department of Energy's Salt Repository Project (SRP) by providing data and models pertinent to showing compliance with Nuclear Regulatory Commission 10 CFR 60 slow-release-limit criteria. Because groundwater movement presumably involves the slow ingress and egress of brine around the waste package, static leach tests provide a realistic simulation of expected hydrodynamic conditions in the engineered barrier system. Data from static leach tests were used to develop an integrated radio-nuclide release model. The integrated model consists of several components also determined from these tests, including saturation concentrations for low-solubility radionuclides, a source term for colloids and pseudocolloids, glass dissolution kinetics, and rate-controlling mechanisms of glass dissolution. The tests are outlined in the FY 1986 Technical Program Plan, WBS Element 0201--Static Testing, for the SRP Defense Glass Studies Program at Pacific Northwest Laboratory. (Lantz-PTT)
W88-07750

ENVIRONMENTAL CONTAMINANTS IN BIRDS: PHOSPHATE-MINE AND NATURAL WETLANDS,
Florida Univ., Gainesville. Dept. of Wildlife and Range Sciences.
T. E. O'Meara, W. R. Marion, C. E. Roessler, G. S. Roessler, and H. A. Van Rinsvelt.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-231973. Price codes: A04 in paper copy, A01 in microfiche. Final Report, November 1986. 77 p, 2 fig, 7 tab, 53 ref, 7 append. Florida Institute of Phosphate Research Grant No. 81-05-001.

Descriptors: *Path of pollutants, *Radioactive wastes, *Birds, *Phosphates, *Wetlands, *Bioaccumulation, Uranium, Waterfowl, Radium, Tissue analysis, Radionuclides, Aluminum, Selenium, Mine wastes, Florida.

Large ponds used to settle the waste clays from Florida's phosphate surface mining operations are attractive to waterfowl, and contain elevated levels of trace elements and radionuclides of the uranium series naturally associated with phosphate ore. Four species of waterfowl were sampled to investigate accumulation of radionuclides and trace elements and to evaluate potential deleterious effects for the birds and humans consuming them. Greater radium-226 levels in the substrate of the settling ponds than in natural wetlands were reflected in elevated concentrations in bones for all four species. Diet/substrate ratios were < 1 for all species in all areas. Bone/substrate ratios differed between settling areas and natural wetlands. Radium-226 levels in soft tissues were consistently less than those in bones, and did not appear to represent an increased threat to humans eating the tissue. No radionuclide standards have been established for waterfowl, although the levels in bird bone, while four times greater than the human maximum, would appear to pose little threat given the birds' short life span. Of the several trace elements found at elevated levels in settling areas, only aluminum and selenium appeared in tissues at concentrations greater than those reported as normal. Specific effects on waterfowl from these contaminants could not be predicted, although the levels do not pose any threat to humans. (Author's abstract)
W88-07754

FIELD DISPERSANT EFFECTIVENESS TEST,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
For primary bibliographic entry see Field 5G.
W88-07755

MESOSCALE ACID DEPOSITION MODEL: PRELIMINARY APPLICATIONS AND A GUIDE FOR USER INTERFACE,
Iowa Univ., Iowa City. Dept. of Chemical and Materials Engineering.
G. R. Carmichael, and L. K. Peters.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227653. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/600/3-87/027, August 1987. 105 p, 26 fig, 6 tab, 39 ref, append. EPA Contract No. DW80931289.

Descriptors: *Mesoscale precipitation, *Acid rain, *Model studies, *Water pollution sources, Air pollution, Industrial wastes, Meteorology, Simulation analysis, Chemical analysis, Sulfur, Mesoscale Atmospheric Simulation System, MASS, Sulfur Transport Eulerian Model, STEM-II.

In 1984, the U.S. EPA initiated a Mesoscale Acid Deposition Study. The study was organized to assess and understand the interactions and importance of local emissions in mesoscale precipitation scavenging. One important component of the project was the simulation of the field events using a detailed meteorological and chemical modeling framework (called MesoSTEM). A dynamical meteorological model, Mesoscale Atmospheric Simulation System (MASS) was used to predict the meteorological fields, including precipitation rates. These fields are used as inputs to a comprehensive chemical model Sulfur Transport Eulerian Model (STEM-II). The three-dimensional models were used to quantify the relationships between emissions, chemical production, and wet deposition on the mesoscale. The linkage of the models, and the application of MesoSTEM to the May 2nd and 3rd, 1985 Philadelphia Mesoscale Field Study data set is the subject of this report. (Author's abstract)
W88-07757

QUARTERLY BRINE MIGRATION DATA REPORT, APRIL-JUNE 1984: NUCLEAR WASTE REPOSITORY SIMULATION EXPERIMENTS (BRINE MIGRATION), ASSE MINE OF THE FEDERAL REPUBLIC OF GERMANY,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
For primary bibliographic entry see Field 5E.
W88-07759

ENVIRONMENTAL MONITORING AT HANFORD FOR 1986.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 4C.
W88-07771

TRITIUM IN GROUNDWATER AT SITE 300,
Lawrence Livermore National Lab., CA.
R. W. Buddemeier, M. R. Ruggieri, and J. A. Oberdorfer.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011695. Price codes: A06 in paper copy, A01 in microfiche. Report No. UCID-21031, April 1987. 165 p, 26 fig, 6 tab, 9 append. DOE Contract No. W-7405-Eng-48.

Descriptors: *Tritium, *Groundwater pollution, *Water pollution sources, *Radioactive wastes, *Path of pollutants, Geohydrology, Groundwater movement, Landfills, Permeability coefficient, Model studies, Groundwater quality, Aquifers.

A continuing investigation is being conducted of groundwater tritium contamination in the vicinity of landfills and an experimental facility at Lawrence Livermore National Laboratory's Site 300, are presented. A program of monitoring groundwater, soil moisture, and rainfall in the study area has produced new insights into geohydrology and contaminant migration in the Pit 7 landfill complex. Groundwater recharge in the area is highly episodic and appears localized in an area to the west of the landfills. Drive points and soil gas analysis were used to explore for tritium sources within the landfills; a region of high concentration has been found in Pit 3, and a lesser but distinct and separate area of activity has been found in the southern portion of Pit 5. The two landfill plumes are separate entities with individual sources and trajectories. Groundwater and tritium migration velocities have been determined for the landfill plumes by a variety of methods: direct observation

of tritium movement, retrospective analysis of tritium displacement, and calculation of water velocities from field determinations of hydraulic gradient and hydraulic conductivity. The most probable values for the Pit 3 and Pit 5 plumes are in the range of 5-20 m/yr, with an upper limit of 60 m/yr in the case of the Pit 5 plume. Analytical models have been used to predict and explore the probable behavior of the landfill plumes. By using a conservative velocity value of 30 m/yr and other model parameters selected to fit the observed plumes, decay-corrected tritium activities are shown to fall below the drinking water standard before either plume reaches the Site 300 boundary. Tritium above background levels has been found at additional locations within the second water bearing zone in the East Firing Area. This appears to represent an extension of the plume that originates near Building 850: it apparently has been transported to the East Firing Area along Doall Ravine streambed. A program of investigation is in progress to characterize the probable future behavior of this plume. (Lantz-PTT)
W88-07772

ORGANIC SOLUTE PROFILE OF WATER FROM RIO BLANCO RETORT 1,
Western Research Inst., Laramie, WY.
R. E. Poulson, J. A. Clark, and H. M. Borg.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-012040. Price codes: A02 in paper copy, A01 in microfiche. Report No. DOE/FE/60177-2366, December 1985. 17 p, 5 fig, 1 tab, 9 ref. DOE Contract No. FC21-83FE60177.

Descriptors: *Water pollution sources, *Rio Blanco, *Water quality, *Oil shales, *Organic compounds, Water analysis, Chemical analysis, Solutes, Gas chromatography, Liquid chromatography, Phenols, Pyridines, Oil wastes, Industrial waste.

Two water samples were taken from the Rio Blanco Oil Shale Company's Retort 1 more than three years after shutdown of the retort burn. The retort had received considerable flushing. These water samples were screened and profiled chromatographically to ascertain the character of the 20-30 ppm TOC remaining in each. The waters contained only organophilic solutes >1 ppb level. Special detection methods with ppb detection limits for selected hydrophilic indicators proved negative for those indicators. Selected indicators ranged from the most hydrophilic (alkanoic acids, alkylamines, and amides) to the least (phenol). The principal species readily identified by either gas chromatography or reversed-phase liquid chromatography were the light polyalkylpyridines and the polyalkylphenols. The two principal individual compounds detected in each water were 2,4,6-trimethylpyridine and 2,3,5-trimethylphenol. The approximate concentrations of each were 200 ppb for a sample taken from the retort center and 400 ppb for a sample taken from the bottom level. Strong flushing of the retort with alkaline water is suggested by (1) the highly accentuated organophilic character of the organic solutes relative to product waters from unexposed retorts that were used for comparison and (2) the enhancement of the alkylpyridine-to-phenol ratio. It appears that there is a residual oil reservoir in the retort serving as a source of organophilic solutes. Any organic material now passing out of the retort would be highly organophilic and predisposed to deposit on even slightly hydrophobic surfaces such as oil shale or retorted oil shale. Other mechanisms on polar surfaces would be operative also, especially for the polar molecules present. Based on the observations in this report, hydrophilic organic solutes may be presumed to be the key indicators for the interaction between oil shale in situ retort effluent and the surrounding environment. Timely monitoring of such sites and development of highly sensitive detection techniques for this class of materials would permit accurate description of migration pathways. (Lantz-PTT)
W88-07773

ACCELERATED LEACH TEST(S) PROGRAM: ANNUAL REPORT,
Brookhaven National Lab., Upton, NY. Dept. of Nuclear Energy.
For primary bibliographic entry see Field 5E.
W88-07774

CONCENTRATIONS OF RADIONUCLIDES IN FISH COLLECTED FROM BIKINI ATOLL BETWEEN 1977 AND 1984,
Lawrence Livermore National Lab., CA.
V. E. Noshkin, K. M. Wong, R. J. Eagle, T. A. Jokela, and J. A. Brunk.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011905. Price codes: A04 in paper copy, A01 in microfiche. Report No. UCID-20754, July 1986. 59 p, 1 fig, 11 tab, 24 ref, append. DOE Contract No. W-7405-Eng-48.

Descriptors: *Path of pollutants, *Radionuclides, *Bioaccumulation, *Fish, *Bikini Atoll, Cesium radioisotopes, Tissue analysis, Strontium radioisotopes, Copper radioisotopes, Bismuth radioisotopes, Radioactivity, Pellagic fish, Plutonium radioisotopes.

All available data on the concentrations of radionuclides in fish samples that were collected for the analysis from Bikini Atoll between 1977 and 1984 are summarized. As found in other global studies, 137-Cs is most highly accumulated in edible flesh of all species of fish, the lowest fractions are found in the bone or liver. The mean concentration of 137-Cs in muscle of reef fish from the southern part of the Atoll is comparable to the global fallout concentration measured in market samples of fish collected in Chicago, IL, in 1982. 90-Sr is generally associated with nonedible parts of fish, such as bone or viscera. Twenty-five to fifty percent of the total body burden of 60-Co is accumulated in the muscle tissue; the remainder is distributed among the liver, skin, and viscera. The mean concentration of 60-Co in fish has been decreasing at a rate faster than radiological decay alone. Most striking is the range of 207-Bi concentrations among different species of fish collected at the same time and place. Highest concentrations of 207-Bi were consistently detected in the muscle (and other tissues) of goatfish and some of the pelagic lagoon fish. In other reef fish, such as mullet, surgeonfish, and parrotfish, 207-Bi was usually below detection limits by gamma spectrometry. More than 70% of the whole-body activity of 207-Bi in goatfish is associated with the muscle tissue, whereas < 5% is found in the muscle of mullet and surgeonfish. Neither 239+240-Pu nor 241-Am were significantly accumulated in the muscle tissue of any species of fish. Apparently, 238-Pu is in a more readily available form for accumulation by fishes than 239+240-Pu. Based on a daily ingestion rate of 200 gm of fish flesh, dose rates to individuals through the fish-food ingestion pathway are well below current Federal guidelines. (Author's abstract)
W88-07776

RAIN PROJECT. ANNUAL REPORT FOR 1984,
Norsk Inst. for Vannforskning, Oslo.
R. F. Wright.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-752495. Price codes: A03 in paper copy, A01 in microfiche. Norwegian Institute for Water Research Report No. NIVA-O-82073, February 1985. 39 p, 11 fig, 6 tab, 7 ref, 2 append.

Descriptors: *Acid rain, *Water pollution effects, *Fate of pollutants, *Norway, Sulfates, Nitrates, Sulfuric acid, Runoff, Precipitation, Nitric acid, Hydrogen ion concentration, Aluminum.

Project RAIN is a 5-year international research project aimed at investigating the effect on water chemistry of changing acid deposition to whole catchments. The project comprises 2 parallel large-scale experimental manipulations - artificial acidification at Sogndal and exclusion of acid rain at Risdalsheia. The project began in June 1983. The first year was devoted to selection of sites, collection of background data on precipitation, runoff and soils, and design and construction of roots, watering systems, weirs and sampling devices. Treatment at Sogndal commenced in April 1984 with the acidification of the snowpack by addition of sulfuric acid on a 1:1 mixture of sulfuric and nitric acids. Treatment continued in August-October 1984. Preliminary results indicate rapid and significant response in runoff chemistry to the acid treatment; pH declines (to as low as 4.1 during snowmelt), SO4, NO3 and labile Al increase. At Risdalsheia treatment began in June 1984 with the mounting of transparent panels on the roofs at KIM catchment (treatment by deacidified rain) and EGIL catchment (control with ambient acid rain). Preliminary data up to 15 October 1984 indicate a decrease in nitrate concentration in runoff from KIM catchment. (Author's abstract)
W88-07777

ROLE OF DRY DEPOSITION IN ACIDIFICATION OF WATERS,
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
F. W. Lipfert.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011301. Price codes: A03 in paper copy, A01 in microfiche. Informal Report No. BNL 35667, September 1984. 29 p, 11 fig, 1 tab, 25 ref. DOE Contract No. DE-AC02-76CH00016.

Descriptors: *Acid raid, *Water pollution sources, *Air pollution, *Dry deposition, *Acidification, Acidic waters, Sulfur, Hydrogen, Throughfall, Stemflow, Sulfates, Evapotranspiration, Hydrogen ion concentration, Canopy.

While much research has been devoted to the micrometeorological aspects of dry deposition processes to various types of surfaces, very little attention has been paid to the ultimate fate of the deposited materials. Many studies of fresh water acidification have ignored this source of acidifying materials from a quantitative viewpoint, while recognizing its existence qualitatively. An approach was developed that concentrates on long-term processes, of the order of seasons or years. The primary source of data is measurements of 'throughfall' composition, i.e., the chemistry of precipitation after it passes through the forest canopy. Since the throughfall and stemflow are dilute solutions of the acidifying materials, both those that were originally deposited dissolved in precipitation and those that were washed off tree leaves (or leached out), one cannot distinguish the origin of the materials found in these solutions. The concentrations of sulfate and hydrogen ion in throughfall and stemflow depend on the amount of moisture lost through evapotranspiration and on the relative importance of dry deposition. Sulfate is invariably higher in concentration in throughfall than in incident precipitation, especially near strong pollution sources; hydrogen ion concentrations can go either way. With respect to fresh water acidification the throughfall and stemflow, as well as materials deposited as forest litter (fallen leaves), must make their way through the watershed into a lake or stream. This process involves additional chemical reactions, usually neutralizing. Data from Europe and the Northeastern U.S. fell along a line of sulfur output equal to about 60% of input. Data from other parts of the U.S. (Tennessee and the Pacific Northwest) showed a relationship of sulfur output equal to about 30% of input. These differences may relate either to soil characteristics or the previous histories of deposition (soil saturation) or, most likely, both factors. A similar data presentation for hydrogen ion showed a threshold, below which all the hydrogen input was retained within the watershed. (Lantz-PTT)
W88-07781

POTENTIAL ORGANIC CONTAMINATION ASSOCIATED WITH COMMERCIALLY AVAILABLE POLYMERIC SORBENTS: CONTAMINANT SOURCES, TYPES, AND AMOUNTS,
Environmental Research and Technology, Inc., Concord, MA.
For primary bibliographic entry see Field 5A.
W88-07794

MUTAGENIC ACTIVITY OF VARIOUS DRINKING WATER TREATMENT LINES,
Lyonnaise des Eaux Central Lab., 38 rue du President Wilson 78239, Le Pecq, France.
For primary bibliographic entry see Field 5F.
W88-07813

ENVIRONMENTAL PROBLEMS AND ISSUES OF AGRICULTURAL NONPOINT SOURCE POLLUTION,
Environmental Research Lab., Athens, GA. Office of Research and Development.
For primary bibliographic entry see Field 5G.
W88-07821

MODELING AGRICULTURAL NONPOINT SOURCE POLLUTION: A RESEARCH PERSPECTIVE,
Environmental Research Lab., Athens, GA. Rural Lands Research.
G. W. Bailey, and R. R. Swank.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 27-47, 8 fig, 103 ref.

Descriptors: *Nonpoint pollution sources, *Model studies, *Agriculture, *Water pollution sources, Legislation, Fate of pollutants, Research priorities, Systems analysis.

Agriculturists have traditionally been concerned with the factors of management and water in the overall crop production equation. Only in the last decade has the relationship between agricultural management practices and water quality and quantity become a major concern. Because of this concern, a need to predict the transport and fate of agricultural pollutants emerged at the beginning of the 1970s. This era of predictive model development for environmental analysis is examined in terms of: (1) Defining the characteristics of agricultural nonpoint source pollution; (2) Use of systems analysis to define and identify the components of the system to be modeled; (3) Modeling rationale and model use; (4) Legislative forces shaping the scope and direction of modeling effort; (5) Accomplishments to date in modeling transport and fate of agricultural nonpoint pollutants; and (6) Needed research and areas of emphasis for 1980. (See also W88-07820) (Lantz-PTT)
W88-07823

TRANSFORMATIONS AND TRANSPORT OF NITROGEN,
Wisconsin Univ.-Madison. Dept. of Soil Science.
D. R. Keeney.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 48-64, 1 fig, 1 tab, 80 ref.

Descriptors: *Nitrogen cycle, *Fate of pollutants, *Path of pollutants, *Nitrogen, *Water quality control, Nitrates, Groundwater pollution, Agriculture, Nonpoint pollution solutions, Model studies, Water quality management, Public health, Eutrophication, Research priorities, Hydrologic cycle, Phosphorus, Soil erosion, Leaching.

Nitrate in groundwaters is of great concern to health and regulatory agencies and the public, yet adverse health effects are difficult to document. Further, the role of N in eutrophication of lakes and impoundments is largely secondary to P. These effects of N are largely site-specific, leading to difficulties in generalization. However, agricultural nonpoint source pollution by N means losing a valuable nutrient resource. Perhaps this is the most important long-term concern. The N and hydrologic cycles are intimately linked and cannot be considered separately when evaluating control of nonpoint source N pollution. Their complexity precludes easy solutions to N pollution problems and frustrates attempts to develop mechanistic models. Research on nonpoint sources of N from surface erosion and runoff should have low priority. Certainly, the amount of N leaving croplands by this route must be minimized, but the overriding concerns of soil loss and P loading of waters are more important. The more difficult problem is NO3(-) pollution of groundwaters. Total management systems are required that will minimize the amount of NO3(-) leaching below the root zone. The approaches will vary, but will include use of cover crops, residue management, and fertilizer management. While rain-fed agriculture offers little opportunity for water management, it is critical in irrigated agriculture. Nitrate pollution arising from irrigated agriculture is the most serious of all nonpoint N source pollution problems and must receive high research priority. More effort is needed to develop effective irrigation-management systems that do not decrease crop yields or greatly increase the expense of operations. Finally, research on models of N transformations and transport must be given high priority. Advances in stochastic modeling promise to finally allow meaningful prediction of field-scale N emissions. Concurrently, models must be developed at the user level to enable meaningful management decisions to be made without the requirement of on-site experimentation to develop yet another wheel. (See also W88-07820) (Lantz-PTT)
W88-07824

CHEMICAL PROCESSES AND TRANSPORT OF PHOSPHORUS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
D. W. Nelson, and T. J. Logan.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 65-91, 3 fig, 3 tab, 117 ref.

Descriptors: *Model studies, *Chemical reactions, *Path of pollutants, *Phosphorus, Mathematical models, Simulation analysis, Runoff, Leaching, Land use, Water quality, Fate of pollutants, Soil water, Sediments, Aquatic life, Aquatic environment.

The chemistry of phosphorus in soils, sediments, and water is complicated and not yet completely understood. In addition, the phenomena involved in the transport of varying forms of phosphorus from the landscape to surface waters is difficult to describe mathematically. However, a variety of equations and simulation models that describe various aspects of P chemistry and transport have been or are being developed. The objective of the work is to review the behavior of the various forms of P in soil and receiving water in relation to development of pollutant transport models. Subject matter covered includes: (1) forms of P in soil and water; (2) transformations of P in soils and water; (3) fate and movement of P in soils; (4) modeling approaches to predict P movement; and (5) availability of P to aquatic organisms. In order to understand P reactions and fate in the environment, an overall simulation model based on relationships in existing models is needed. Integration of the many aspects of P chemistry and transport can only be accomplished by a team of scientists, each with expertise in one or more of the subroutines which would make up an overall simulation model in P. If an overall model that describes P reactions in soil, P transport by runoff and leaching, and P reactions in aquatic environments could be developed, the assessment of the effects of land use and management on water quality would be greatly simplified. Such a model would permit planners to identify the best mix of management practices needed to give the reductions in P discharge necessary to improve water quality. (See also W88-07820) (Lantz-PTT)
W88-07825

ATMOSPHERIC DEPOSITION OF NUTRIENTS AND PESTICIDES,
Iowa State Univ., Ames. Dept. of Agronomy.
M. A. Tabatabai.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 92-108, 14 tab, 32 ref.

Descriptors: *Acid rain, *Water pollution sources, *Nutrients, *Pesticides, *Air pollution, *Path of pollutants, Fate of pollutants, Rain, Runoff, Groundwater movements, Soil water, Cobalt, Copper, Manganese, Molybdenum, Zinc, Phosphorus, Potassium, Calcium, Magnesium, Sulfur, Ammonium, Nitrogen, Hydrogen ion concentration.

The effect of H(+) ion concentration in precipitation on soils cannot be assessed because precipitation contains NH4(+), and this ion has an acidifying potential of a similar magnitude to direct H(+) inputs common in rainfall. Therefore, the amount of acidity produced in soils by precipitation, especially in agricultural soils, is insignificant in relation to the acidity from other sources. Sixteen elements are required for plant growth and development. These are grouped into macronutrients and micronutrients. The macronutrients are those elements required in relatively large amounts. The macronutrients that receive the most attention are N, S, P, K, Ca, and Mg. Of these elements, only N and S, and the micronutrient Cl can be present in gaseous forms, salts in aerosols, and compounds associated with suspended particulates in the atmosphere. The other elements (P, K, Ca, and Mg) are present in the atmosphere in suspended particulates. The concentration of the micronutrients Co, Cu, Mn, Mo, and Zn in precipitation from various locations in remote, rural, and urban areas are summarized in tabular form. In general, the concentrations of these elements are lowest in remote areas and highest in urban areas. Micronutrient additions by precipitation to soils are small relative to the amounts present in soils. It is very doubtful if the micronutrients present in precipitation would alter the quality of runoff water from cropland. Pesticides are among the man-made contaminants introduced into the atmosphere through insect, fungus, nematode, rodent, and weed control activities. During application to soil or crops, pesticides may be lost as spray drift or by volatilization. Because the vapor pressures of many pesticides are high, a portion of the applied pesticide is lost from plants, soils, and surface water into the atmosphere. The concentrations of pesticides in precipitation are about 1,000 times lower than those found in surface runoff. Therefore, it is very unlikely that pesticides in precipitation contribute significantly to contamination of surface runoff. Most of the information available on pesticides in the atmosphere is related to their concentrations in air and only recently have methods been developed for accurate determination of pesticides in precipitation. (See also W88-07820) (Lantz-PTT)
W88-07826

CHEMICAL PROCESSES AND TRANSPORT OF ANIMAL WASTE POLLUTANTS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
M. R. Overcash, and K. R. Reddy.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 109-125, 10 fig, 4 tab, 17 ref. EPA Grant No. R-805011-0-1-0.

Descriptors: *Model studies, *Animal wastes, *Path of pollutants, *Fate of pollutants, *Chemical degradation, *Simulation analysis, Watkinsville, Georgia, Runoff, Computer programs, Simulation analysis, Nitrogen, Nitrates, Phosphorus, Phosphates, Carbon, Coliforms, Nutrients, Seasonal variation, Nitrogen compounds, Sensitivity analysis, Phosphorus compounds.

Using the available rainfall-runoff data for the Watkinsville, Georgia, P2, watershed and the revised Agricultural Runoff Model (ARM II): Animal Waste Version, a series of computer runs was made to verify the computer code and to study the effects of various animal waste application practices, such as waste loading rate, timing and frequency of application, and waste types on runoff water quality. Sensitivity analysis was also conducted to evaluate the effect of kinetic reaction rate changes on runoff water quality. Most simulations were for soils treated with swine wastes. The kinetic rate constants used in the simulations were obtained from the literature. Sediment yield and runoff were highest during the month of May followed by June, July, September, and December, respectively. The quantity of the nutrients transported in runoff water was expressed in mass units (kg/ha). The data presented are simulated values, and at this time no experimental verification of the model is available. Results of simulation of the effect of swine waste loading rate on nutrient transport show that increased rate of waste appli-

cation increased the ORG-N, ammonium N, nitrate N, ORG-P, soluble PO4-P, soluble C, and fecal coliforms in the runoff water. Runoff nutrient loadings were simulated for swine wastes applied at 200 kg N/ha each in May, August, and December compared to one waste loading rate (600 kg N/ha) applied in May. Nitrogen and carbon concentrations of the runoff water were lower in the case of frequent applications of waste compared to heavy application. Soluble P concentration of the runoff water showed a reverse trend. More fecal coliforms were observed in the treatment receiving three waste applications than in the treatment receiving one heavy application in summer. This was primarily due to longer survival periods of fecal coliforms in winter compared to summer applications. As shown by the simulation results, the ARM II, can satisfactorily represent the behavior of pollutants in runoff water. In the future, simulated values should be rigorously tested with experimental values before any changes in the model are made. (See also W88-07820) (Lantz-PTT)
W88-07827

RETENTION AND TRANSFORMATIONS OF PESTICIDES IN RELATION TO NONPOINT SOURCE POLLUTION FROM CROPLANDS,
Florida Univ., Gainesville.
P. S. C. Rao, P. Nkedi-Kizza, J. M. Davidson, and L. T. Ou.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 126-140, 5 fig, 5 tab, 27 ref. EPA Grant Nos. R-805529 and R-805794.

Descriptors: *Fate of pollutants, *Nonpoint pollution sources, *Agriculture, *Path of pollutants, *Pesticides, Soil contamination, Soil water, Transformation, Sorption, Leaching, Organic carbon, Kinetics, Chemical reactions, Runoff, Rainfall, Degradation, Overland flow.

A major pathway for pesticide removal from croplands, especially in terms of pesticide movement to nontarget areas, is in runoff water and on sediment carried in that water. The amount of soil-applied pesticide which leaves the field in this manner depends primarily on the intensity and the duration of the rainfall event, and the time lag between pesticide application and the runoff event. The depth of soil layer (i.e., mixing zone from which pesticides are removed during a runoff event is determined by the intensity and duration of the rainfall event. The amount of pesticide available within this mixing zone is determined by the extent of pesticide dissipation that occurs between application and a given runoff event. Various process governing the fate of pesticides in soils are: retention (adsorption-desorption), transformations (microbial and chemical degradation), and transport (overland flow, leaching, and volatilization). Based on the data available presently, the following justifiable simplifications for estimating parameters for pesticide sorption and transformations are proposed: (1) As demonstrated in an earlier study, errors associated with various simplifying assumptions such as linear, singular isotherms, and instantaneous equilibrium appear to be within a factor of 2 or 3 in many cases; (2) Pesticide sorption on whole soils and soil size-separates is determined primarily by the soil organic carbon content; (3) The degradation rate of pesticides can be described by first-order kinetics. Temperature and soil-water tensions are generally considered to be the two major environmental factors which significantly influence pesticide degradation; and (4) During degradation of the pesticides in soils, significant amounts of bound residues may be formed. These bound residues are carried with the sediment and could end up in the bottom sediments in the receiving water bodies. (See also W88-07820) (Lantz-PTT)
W88-07828

POTENCY FACTORS AND LOADING FUNCTIONS FOR PREDICTING AGRICULTURAL NONPOINT SOURCE POLLUTION,
Tetra Tech, Inc., Lafayette, CA.
J. D. Dean.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 155-177, 3 fig, 14 tab, 68 ref.

Descriptors: *Path of pollutants, *Agriculture, *Nonpoint pollution sources, *Mathematical studies, *Potency, Pesticides, Erosion, Particulate matter, Sediments, Organic matter, Path of pollutants, Pesticides, Pollutant load, Computer models, Sediment Load, Storms, Enrichment, Adsorption.

Because of the inherent difficulties in transferring potency factors from watershed to watershed, the separate estimation of soil concentration and enrichment ratios which constitute the potency factor was attempted. This is a logical separation into factors which represent the processes of supply and transport. This not only facilitates the estimation of P sub n (a factor relating the load of pollutant n associated with each unit load of sediment (pollutant mass/sediment mass; known as a loading function and P is called a potency factor), but should also facilitate extrapolation of the results to other situations. Prediction of pesticide peak loads continues to be a problem in hand calculation methods due to the inadequacy of techniques to predict individual storm sediment loads. Because of recent advances in computer modeling of sediment by size-fraction, pollutant loss predictions by potency factors has improved concurrently. However, very little work has been done to evaluate enrichment ratios for pesticides and then only for a few compounds. Because of the large number of pesticides in use, there is a need to at least empirically relate enrichment factors to more well-known physical or chemical parameters (e.g., partition coefficient). The enrichment ratio of pollutant n (pollutant mass in eroded sediment/pollutant mass in surface soil), and R = the ratio of the mean particle density of surface soil to the mean particle density of eroded sediment (dimensionless), represents the effects of several processes which cause the ratio of the mass of pollutant to sediment to be higher at the stream edge than at the source back in the watershed. One of the major processes is the preferential detachment and transport of fine particles such as organic aggregates, clays, and silts. It is a well-known fact that these particles have more chemical and physical interaction with dissolved substances. To the extent that the pollutant is adsorbed to eroded sediment, the enrichment of fine soil particles in runoff will have an impact on its loss. For less strongly adsorbed pollutants, this effect diminishes, but the degree of mixing and equilibrium in the active surface layers becomes more important. (See also W88-07820) (Lantz-PTT)
W88-07830

CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5G.
W88-07831

PREDICTING WATER QUALITY RESULTING FROM AGRICULTURAL NONPOINT SOURCE POLLUTION VIA SIMULATION - HSPF,
Anderson-Nichols and Co., Inc., Palo Alto, CA.
A. S. Donigian, J. C. Imhoff, and B. R. Bicknell.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 200-249, 14 fig, 15 tab, 31 ref. EPA Contract No. 68-03-2895.

Descriptors: *Hydrologic models, *Water quality, *Nonpoint pollution sources, *Simulation analysis, *Computer models, *Water quality management, *Hydrologic Simulation Program-Fortran, Computer programs, HSPF, Tillage, Agricultural practices, Pesticides, Nutrients, Model studies, Watersheds.

Comparison of water quality conditions under conventional agronomic practices and Best Management Practices (BMPs) provides the basis for determining the net effects and associated benefits of BMP implementation. Using simulated concentrations of pesticides and other toxic pollutants in conjunction with lethality-duration information, the frequency of acute and chronic toxic conditions can be determined to assess the aquatic impact of proposed practices. The primary conclusions of this study are related to the results of Hydrologic Simulation Program-FORTRAN (HSPF) simulations on field and watershed ss, the problem of field-to-stream delivery, and the ability to evaluate and represent BMP effects with HPSF. On the field ss it is clear that tillage practices dominate the response of individual fields. Pesticide decay rates were highly variable, and it is clear that a better predictive capability is needed in terms of representing and predicting pesticide decay in the field under various environmental conditions and factors. A key conclusion of this study was that the sediment, pesticide, and nutrient parameters calibrated on the field ss performed well at the watershed scale, primarily due to the hydrologic simulation that provided a good representation of the transport mechanisms. Experience with the model in this study, has shown that HSPF provides a viable and flexible means of estimating the impacts of a wide range of candidate BMPs. The model allows the user to closely analyze and demonstrate the impacts of specific assumptions incorporated within a BMP (i.e., chemical application, method, and timing). However, true verification of the ability to simulate the effects of BMPs must await the availability of post-BMP implementation data. (See also W88-07820) (Lantz-PTT)
W88-07832

METHODOLOGY FOR PREDICTING EXPOSURE AND FATE OF PESTICIDES IN AQUATIC ENVIRONMENTS,
Environmental Research Lab., Athens, GA. Office of Research and Development.
L. A. Mulkey, and J. W. Falco.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 250-266, 5 fig, 3 tab, 27 ref.

Descriptors: *Population exposure, *Environmental effects, *Fate of pollutants, *Pesticides, *Aquatic environment, *Water pollution effects, Mathematical studies, Bioassays, Chlorinated compounds, Hydrocarbons, Risk analysis, Toxicity, Mathematical models, Aquatic life, Fishkill, Ecosystems.

Evidence of potentially harmful effects of pesticides on aquatic organisms has led to intensive efforts to assess environmental risks posed by existing and new chemicals. Laboratory bioassay tests, environmental damage episodes like fish kills, and information about pesticide properties have all been studied with a view toward estimating or assigning risk associated with pesticide use patterns and related management practices. These environmental observation procedures have been effectively applied to a number of pesticide-related environmental problems, most notably those associated with chlorinated hydrocarbons. Concern about pesticides is related to effects or damage. Risk implies the likelihood or probability of such effects. The study of this exposure (exposure assessment) is defined as a quantitative evaluation of the concentration of pesticides in various environmental media as the pesticide is released, transported, and transformed among and within environmental compartments. The development of mathematical models, as presented in this paper, aids in the evaluation of these pesticides in aquatic ecosystems. (See also W88-007820) (Lantz-PTT)
W88-07833

CALIBRATION AND TESTING OF NUTRIENT AND PESTICIDE TRANSPORT MODELS,
GKY and Associates, Inc., Springfield, VA.
G. K. K. Young, and C. L. Alward.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 267-277, 3 fig, 1 tab, 7 ref. EPA Contract No. 68-03-2666.

Descriptors: *Model studies, *Pesticides, *Nutrients, *Path of pollutants, Performance evaluation, Agricultural Runoff Model, Nonpoint Source Runoff Model, Statistical analysis, Runoff, Seasonal variation, Sediment transport, Water quality, Statistical models, Hydrologic models, Small watersheds, Frequency analysis.

The predictive capabilities of the Agricultural Runoff Model (ARM) and Nonpoint Source Runoff Model (NPS) were examined. The first step toward this end was calibration of the models using both manual methods an automated Gauss-Newton search algorithm. Testing procedures involved characterization of model error using the coefficient of variation the Kolmogorov-Smirnov-S goodness-of-fit test, and the Chi-squared goodness-of-fit test. Calibration and testing were performed by separate firms in order to maintain maximum objectivity throughout the model evaluation process. It was determined that these models could be calibrated fairly well for monthly and seasonal values as well as for runoff and sediment over one- to two-year periods. Testing of the ARM and NPS models revealed that simulated hydrology and sediment frequency functions fit prototype outputs better than pesticide and water quality results. The data used in this work were from watersheds near the minimum recommended size range for application of the models. Specific conclusions are: (1) Split independent data sets should be used; one for calibration and the other for testing; (2) The testing procedure should be quantitative with numeric metrics selected to depict results that measure accuracy and precision. Qualitative description of model performance should be minimized; (3) The protocol used in this project with independent parties conducting calibration and testing is sound and leads to unbiased results; (4) Pesticide and sediment transport models as tested in the project do not simulate outputs that synchronize with prototype measurements to any degree of precision. The problem may be in the small scale of watershed, improper synchronization of forcing function inputs and measured outputs, or model errors; and (5) Model outputs lead to derived frequency functions that agree with prototype frequency functions in a large number of tests but not in all. (See also W88-07820) (Lantz-PTT)
W88-07834

CASE STUDY FOR CONTROL OF BORON POLLUTION,
State Planning Organization, Sectoral Programming Dept., Ankara (Turkey).
For primary bibliographic entry see Field 5C.
W88-07869

LAND APPLICATION OF SLUDGE: FOOD CHAIN IMPLICATIONS.
For primary bibliographic entry see Field 5E.
W88-07904

EFFECTS OF SOIL PROPERTIES ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
Colorado State Univ., Fort Collins.
L. Sommers, V. Van Volk, P. M. Giordano, W. E. Sopper, and R. Bastian.
IN: Land Application of Sludge: Food Chain Implications. Lewis Publishers, Inc., Chelsea, Michigan. 1987. p 5-24, 8 tab, 45 ref.

Descriptors: *Trace elements, *Path of pollutants, *Land application, *Sludge disposal, *Land disposal, *Bioaccumulation, *Heavy metals, Soil properties, Crop production, Trace metals, Soil physical properties, Iron, Molybdenum, Selenium, Phytotoxicity, Soil contamination, Hydrogen ion concentration, Organic matter, Aluminum, Acidification.

The fate and effects of sewage sludge constituents in a soil-plant system are influenced by such soil properties as pH, organic matter, cation exchange capacity, iron and aluminum oxides, texture, aeration, specific sorption sites and water availability. Knowlege of a soil's total trace element content enables a preliminary evaluation of metal contamination from prior waste disposal activities before any further application of sludge is made. A need still exists for a standard extractant to assess the level of plant available metals in soils. The regional project W-124 (Optimum Utilization of Sewage Sludge on Cropland) has collected data on the uptake of metals by barley grown at 15 locations in the U.S. that were treated with sewage sludge. Sludge-treated soil showed increased metal concentrations for soil and plant tissues with a single 100 mt/ha or annual applications of 20 mt/ha. Sewage sludge additions can be used to correct Fe deficiency in calcareous soils. Based on plant uptake, molybdenum is the principal metal of concern in calcareous soils treated with sewge sludge. The relationship of either cation exchange capacity or texture to metal uptake in sewage sludge-amended soils has not been conclusively demonstrated under field conditions. The impact of the pH reduction on increased metal uptake is more marked with high metal sludges and crops responsive to metal additions. (See also W88-07904) (Geiger-PTT)
W88-07905

EFFECTS OF SLUDGE PROPERTIES ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
Wisconsin Univ., Madison. Dept. of Soil Science.
R. B. Corey, L. D. King, C. Lue-Hing, D. S. Fanning, and J. J. Street.
IN: Land Application of Sludge: Food Chain Implications. Lewis Publishers, Inc., Chelsea, Michigan. 1987. p 25-51, 5 fig, 9 tab, 59 ref.

Descriptors: *Solubility, *Soil genesis, *Bioaccumulation, *Sludge disposal, *Land application, *Path of pollutants, *Waste characteristics, Municipal wastes, Heavy metals, Trace metals, Soil contamination, Adsorption, Mathematical models, Soil physical properties, Soil types, Hydrogen ion concentration, Phytotoxicity, Solute transport.

Trace elements in raw sewage remain as suspended solids in the sludge following wastewater treatment. Over the past decade, concentrations of trace elements in many publicly-operated treatment works sludges have decreased markedly as a result of implementing industrial waste pretreatment, and this trend is expected to continue. During sewage treatment, addition of materials containing Fe, Al, or lime reduces solubilities of metals in sludges. A variety of factors determine equilibrium trace element solubility in sludges, particularly the presence of trace-element precipitates, the strength of bonding to organic and mineral adsorption sites, the proportion of potential adsorbing sites filled, and the presence of dissolved ligands capable of complexing the trace elements. If, within the pH range normally found in soils of a given region, a sludge maintains the availability of a trace element below the level that caused phytotoxicity or potentially harmful accumulation of that element, there is no need to limit land application of that sludge because of that element. If, within the pH range normally found in soils of a given region, a sludge maintains the availability of a trace element above the level that causes phytotoxicity or potentially harmful accumulation of that element, loading limits should be established based on characteristics of the sludge and of the soil to which it is applied that interact to control the availability of that element. Development of methods for measuring trace-element desorption characteristics of sludges and adsorption characteristics of soils (particularly for Cd, Zn, Ni and Cu) should be given high priority. Immediately following land application all sludges will undergo changes which will affect trace element solubility and plant uptake. This effect is a function of sludge treatment prior to land application. Most research indicates that plant availability of sludge- derived metals stays the same or decreases with time following their land application. (See also W88-07904) (Author's abstract)
W88-07906

EFFECTS OF LONG-TERM SLUDGE APPLICATION ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. C. Chang, T. D. Hinesly, T. E. Bates, H. E. Doner, and R. H. Dowdy.
IN: Land Application of Sludge: Food Chain Implications. Lewis Publishers, Inc., Chelsea, Michigan. 1987. p 53-66, 4 fig, 9 tab, 23 ref.

Descriptors: *Land application, *Path of pollutants, *Sludge disposal, *Bioaccumulation, *Heavy metals, *Land disposal, Cadmium, Zinc, Copper, Nickel, Municipal wastes, Trace metals, Absorption, Crop production, Phytotoxicity, Soil physical properties, Soil contamination, Metal availability.

Application of cadmium (Cd) and zinc (Zn) to soils from municipal sludge will cause the Cd and Zn concentration of plants grown on these soils to exceed those of the untreated controls. When the sludge is applied at rates to satisfy the nitrogen requirement of the crop grown, the Cd and Zn contents of plant tissue remain at nearly constant levels with successive sludge applications. In sludge treated soils maintained at pH >6.0, copper (Cu) and nickel (Ni) contents of the tissue from plants grown on these soils may become slightly elevated. Phytotoxicity from sludge-applied Cu and Ni, however, has rarely been reported. Given adequate time for sludge to equilibrate with the soil, metal concentration of the affected plant tissue would be determined by the total amounts of metals in the soil and would not be affected by the methods of sludge application (e.g., single addition vs. multiple applications to yield the same total application as the single addition). Plant availability of sludge-borne metals is highest during the first year sludge is applied. Using the first year response curve generated by a large single sludge addition will overestimate metal accumulation in vegetative tissue from plants grown in well stabilized sludge/soil systems. There are no field data to indicate that trace element concentration in plant tissue will rise after the termination of sludge applications if chemical conditions of the soil remain constant. Cadmium and zinc levels of plants grown in soils which are no longer receiving sludges either were not significantly different from the pretreatment levels or decreased with time. (See also W88-07904) (Author's abstract)
W88-07907

TRANSFER OF SLUDGE-APPLIED TRACE ELEMENTS TO THE FOOD CHAIN,
R. L. Chaney, R. J. F. Bruins, D. E. Baker, R. F. Korcak, and J. E. Smith.
IN: Land Application of Sludge: Food Chain Implications. Lewis Publishers, Inc., Chelsea, Michigan. 1987. p 67-99, 13 tab, 105 ref.

Descriptors: *Diets, *Land application, *Bioaccumulation, *Food chains, *Trace elements, *Sludge disposal, *Land disposal, *Path of pollutants, Adsorption, Trace metals, Heavy metals, Soil contamination, Cadmium, Water pollution effects, Biological magnification, Crop production, Zinc, Nickel, Molybdenum, Selenium, Hydrogen ion concentration, Public health.

Conditions for valid assessment of relative increased crop concentration of an element due to sludge application to cropland are limited to long-term sludge amended soils, preferably 2 or more years after sludge is applied. Some trace elements can be increased in edible crop tissues when sewage sludges rich in the element are applied to acidic soils (Cd, Zn, Ni), or alkaline soil (Mo). Under these conditions (responsive conditions), the relative increase in element concentration among crop species are sufficiently consistent to be relied upon in dietary exposure modeling. High organic matter and high soil pH both reduce element uptake (except for Mo and Se). Except for corn inbreds, cultivar variation in element concentration has been found to be approximately 2- to 5-fold. Because of inclusion of various cultivars in the food supply, this variation would not significantly alter chronic exposure due to increased crop uptake of sludge applied elements. If the FDA food groups are used in dietary Cd modeling, they should be adjusted for relatively high and low Cd accmumulating crop types within a food group. Food intake should represent average adult intake for 50 years. Increased Cd uptake by all garden foods can be integrated in terms of increased Cd uptake by a reference crop such as lettuce. Dietary Cd increase can be predicted by the response of Cd concentration in lettuce grown in test soils times the integrated garden foods Cd intake factor. Increase in dietary Cd due to growing 100% of consumed garden vegetables on sludge-amended acidic garden soils was estimated as 2.20 micro-

grams Cd/day when lettuce is increased above background by 1 mg/kg dry lettuce. Prediction of changes in kidney Cd due to increases in dietary Cd from foods grown in acidic sludge-amended gardens should consider effects of nutritional status and nutrients in the garden crops on Cd retentinon by humans. Ingestion of sludge can allow exposure and/or risk which can be prevented by incorporation of sludge below the soil surface, or by tilling sludge into the soil. (See also W88-07904) (Geiger-PTT)
W88-07908

EFFECTS OF TRACE ORGANICS IN SEWAGE SLUDGES ON SOIL-PLANT SYSTEMS AND ASSESSING THEIR RISK TO HUMANS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5C.
W88-07909

MATHEMATICAL MODELLING OF RADIONUCLIDE MIGRATION IN GROUNDWATER,
Theoretical Physics Division, Atomic Energy Research Establishment, Harwell, Oxfordshire, UK.
For primary bibliographic entry see Field 5E.
W88-07911

PROBLEMS IN THE RECOGNITION OF SEAWATER INTRUSION BY CHEMICAL MEANS: AN EXAMPLE OF APPARENT CHEMICAL EQUIVALENCE,
Birmingham Univ. (England). Hydrogeology Section.
J. H. Tellham, and J. W. Lloyd.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 4, p 389-398, 1986. 6 fig, 2 tab, 26 ref.

Descriptors: *Groundwater, *Saline water, *Hydrogeology, *Saline water intrusion, *Aquifers, *Saline aquifers, *Chemical properties, Chemical equivalence, Hydrochemical methods, Aquifers, England, Computer models, Ions.

The determination of the origin of saline groundwaters is sometimes crucial for the successful exploitation of an aquifer system. Although hydrochemical methods provide a direct approach to the problem, modification of intruding water can often give rise to interpretational difficulties. By means of a case history from the Permo-Triassic sandstone aquifer of the Widnes-Manchester area, the problems encountered are illustrated. The major ion chemistries of (a) saline waters originating from upconing of deep old saline water and (b) saline groundwaters resulting from recent intrusion are compared using computer modeling techniques with a third group of waters of unknown provenance. In some cases an apparent chemical equivalence, in which the same chemical product can arise through more than one set of processes, can occur; in such cases major ion analyses alone are not of use in determining groundwater origins. (Author's abstract)
W88-07917

FACTORS AFFECTING PORE WATER HYDROCARBON CONCENTRATIONS IN PUGET SOUND SEDIMENTS,
Washington Univ., Seattle. School of Oceanography.
S. B. Socha, and R. Carpenter.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 5, p 1273-1284, May 1987. 4 fig, 4 tab, 48 ref.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Hydrocarbons, *Interstitial water, *Pollutants, *Sediment concentration, *Estuarine sediments, Path of pollutants, Partition coefficients, Mathematical models, Washington, Estuaries, Solubility, Puget Sound, Creosote, Industrial wastewater.

Polycyclic aromatic hydrocarbon (PAH) and aliphatic hydrocarbon concentrations have been determined for sediments and associated pore waters collected at 2 sites (11 stations) in Puget Sound, Washington (northwest USA). These sediments have been contaminated to varying degrees by hydrocarbons from a creosote plant and from various combustion sources. PAH were not detected in pore waters of sediments whose PAH were primarily derived from combustion and natural sources, even though pore water concentrations predicted from sediment concentrations and 2-phase equilibrium partitioning models were above detection limits from most PAH. Equilibrium partition coefficients calculated from field aqueous and solid phase data from an area contaminated with creosote agreed with laboratory-derived coefficients to within a factor of plus or minus 4. Pore water concentrations of creosote-derived aliphatic hydrocarbons increase with increasing concentration in bulk sediments. However, pore water concentrations of natural and contaminant aliphatic hydrocarbons are much higher than predicted by solubility data, possibly due to association with nonfilterable dissolved organic matter and colloids. Other major factors controlling hydrocarbon pore water concentrations include differential hydrocarbon sources, specific particle associations and solubility. (Author's abstract)
W88-07927

ALUMINUM CHEMISTRY: FRACTIONATION, SPECIATION, AND MINERAL EQUILIBRIA OF SOIL INTERSTITIAL WATERS OF AN ALPINE WATERSHED, FRONT RANGE, COLORADO,
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.
M. I. Litaor.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No.5, p 1285-1295, May 1987. 8 fig, 4 tab, 53 ref, append.

Descriptors: *Acid rain, *Path of pollutant, *Alpine regions, *Front range, *Soil chemistry, *Aluminum, *Interstitial water, *Acidic soils, *Pollutants, *Air pollution effects, Aluminum solubility, Watersheds, Colorado, Computer models, Mathematical models, Solute transport, Minerals, Soil water, Hydrogen ion concentration, Sulfates.

Soil interstitial waters and minerals were collected and analyzed to evaluate the influence of acid deposition on Al chemistry in the soil environment of the Green Lakes Valley Front Range, Colorado. The soil solutions were subjected to a series of batch Al experiments followed by computer modeling to separate the labile from the nonlabile Al, and to estimate the activity of Al(3+). The Al solubility in the interstitial waters is complex and is controlled by organic solutes, H4SiO4, and pH. The pH and concentrations of SO4(2-) do not correlate with Al concentrations. The chemical equilibria of Al are controlled by amorphous aluminosilicate Al(OH)3(1-x) SiO2x. Studies of mineralogy and soil water chemistry provide a useful combination to evaluate and predict the chemical processes of a soil environment. (Author's abstract)
W88-07928

PROCESSES AND KINETICS OF CD(2+) SORPTION BY A CALCAREOUS AQUIFER SAND,
Geological Survey, Menlo Park, CA. Water Resources Div.
C. C. Fuller, and J. A. Davis.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 6, p 1491-1502, June 1987. 12 fig, 4 tab, 70 ref.

Descriptors: *Sand aquifers, *Fate of pollutants, *Path of pollutants, *Groundwater, *Cadmium, *Heavy metals, *Water pollution effects, *Adsorption, *Calcareous soils, Mathematical analysis, Aquifers, Wastewater analysis, Carbonates, Hydrogen ion concentration, Solute transport, Pollutants.

The rate of Cd(2+) sorption by a calcareous aquifer sand was characterized by 2 reaction steps, with the first step reaching completion in 24 hours. The second step proceeded at a slow and nearly constant rate for at least 7 days. The first step includes a fast adsorption reaction which is followed by diffusive transport into either a disordered surface film of hydrated calcium carbonate or into pore spaces. After 24 hours the rate of Cd(2+) sorption was constant and controlled by the rare of surface coprecipitation, as a solid solution of CdCO3 in CaCO3 formed in recrystallizing material. Desorption of Cd(2+) from the sand was slow. Clean grains of primary minerals, e.g. quartz and aluminosilicates, sorbed much less Cd(2+) than grains which had surface patches of secondary minerals, e.g. carbonates, iron and manganese oxides. Calcite grains sorbed the greatest amount of Cd(2+) on a weight-normalized basis despite the greater abundance of quartz. A method is illustrated for determining empirical binding constants for trace metals at in situ pH values without introducing the experimental problem of supersaturation. The binding constants are useful for solute transport models which include a computation of aqueous speciation. (Author's abstract)
W88-07930

MODELLING CHEMICAL EQUILIBRIA OF ACID MINE-DRAINAGE: THE FESO4-H2SO4-H2O SYSTEM,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. J. Reardon, and R. D. Beckie.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 9, p 2355-2368, September 1987. 8 fig, 7 tab, 38 ref.

Descriptors: *Acid mine drainage, *Mathematical models, *Minerals, *Inorganic acids, *Sulfates, *Sulfuric acid, *Ferrous sulfate hydrates, Melanterite, Szomolnokite, Geochemistry, Pitzer formula, Thermodynamics, Ions, Temperature.

Chemical equilibria in the FeSO4-H2SO4-H2O system have been modeled using the Pitzer formulation for the determination of activity coefficients over the range from 10 to 60 C. The available experimental activity coefficient, enthalpy, heat capacity and mineral solubility data have been analyzed to determine the temperature dependencies of the various ion interaction parameters necessary to describe chemical equilibria in this system. In this analysis, the previously published ion interaction parameters in the H2SO4-H2O system have been reevaluated incorporating the higher-order electrostatic terms in the Pitzer formulation to account for asymmetric mixing of ions of dissimilar valence. The combined set of interaction parameters yield an accurate description of equilibria in the FeSO4-H2O system over the temperature range of 10 to 90 C and concentration conditions up to the solubility limit of ferrous sulfate hydrate. From an appraisal of solubility data for ferrous sulfate hydrates in water using these parameter expressions, the relations for the temperature dependence of the solubility products for the heptahydrate (melanterite) and the monohydrate (szomolnokite) have been derived. A comprehensive evaluation of ferrous sulfate hydrate solubility data sulfuric acid solutions enabled the determination of the various additional parameters needed to describe the mixed system, FeSO4-H2SO4-H2O. The final model yields an excellent representation of all available mineral solubility data for the combined FeSO4-H2SO4-H2O system over a temperature range from 10 to 60 C, sulfuric acid concentrations from 0 to 6 molal and for iron sulfate concentrations up to the solubility limit. (Author's abstract)
W88-07933

SEASONAL AND ANNUAL VARIATIONS IN THE ORGANIC MATTER CONTRIBUTED BY THE ST. LAWRENCE RIVER TO THE GULF OF ST. LAWRENCE,
Department of Fisheries and Oceans, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, N.S., Canada B2Y 4A2.
For primary bibliographic entry see Field 2E.
W88-07934

MODEL APPROACH TO ACID RAIN,
Laboratory for Waste Materials and Emissions, the National Institute for Public Health and Environmental Protection, Bilthoven, the Netherlands.
For primary bibliographic entry see Field 6B.
W88-07943

INTERACTIONS OF CO57, SR85 AND CS137 WITH PEAT UNDER ACIDIC PRECIPITATION CONDITIONS,
Pittsburgh Univ., PA. Graduate School of Public Health.
A. L. Sanchez, W. R. Schell, and E. D. Thomas.
Health Physics HLTPAO, Vol. 54, No. 3, p 317-322, March 1988. 2 tab, 35 ref.

Descriptors: *Peat, *Radioactive wastes, *Radioactive waste disposal, *Radioisotopes, *Acid rain, *Soil acidity, *Cobalt radioisotopes, *Strontium radioisotopes, *Cesium radioisotopes, Nuclear waste repositories, Chemical properties, Peat barrier, Organic complexes, Migration retardation.

Following the burial of low-level wastes in nuclear waste repositories, the interactions of radionuclides with surrounding soil infiltrated by acid precipitation could cause radionuclide migration and transport into nearby wells. To evaluate this migration through organically rich soil in the unsaturated zone, we measured sorption and desorption distribution ratios (R sub d) of Co57, Sr85, and Cs137 onto peat at pH 4. Peat samples rich in organic C showed relatively higher sorption R sub d values for Co57 and Sr85 compared with soil samples with less organic C. The sorption and desorption R sub d values for these radionuclides are similar, indication the reversibility of the sorption process. The measurements suggest the importance of organic complexes for the retention of these radionuclides at the pH range (pH 4), where hydrolysis of the metals is not important and sorption is expected to be low. Cs137 appears to be associated more strongly with organic components of the soil samples, with its R sub d value significantly higher in the peat material containing less organic C. The Cs137 desorption R sub d on the same peat sample is also comparable to the sorption R sub d indicating equilibrium. Both the organic and inorganic components of peat are thus able to retard the migration of radionuclides which may be found in nuclear waste repositories. The design of such a repository may be improved using a peat barrier to restrict radionuclide migration. (Author's abstract)
W88-07944

GRID REFINEMENT APPROACH TO FLOW AND TRANSPORT MODELING OF A PROPOSED GROUNDWATER CORRECTIVE ACTION AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
GeoTrans, Inc., Herndon, VA.
G. M. Duffield, D. R. Buss, D. E. Stephenson, and J. W. Mercer.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010198. Price codes: A03 in paper copy, A01 in microfiche. 40 p, 21 fig, 5 tab, 6 ref. Contract No. DE-AC09-76SR00001.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Hydraulic models, *Fate of pollutants, *Path of pollutants, *Mathematical models, *Solute transport, *Monitoring, *Flow characteristics, Flow measurement, Remedies, Leakage, Separation Techniques, Hydraulic profiles, Hydraulic systems, Groundwater management, Least squares method, Algorithms, Savannah River Plant.

At the Savannah River Plant (SRP), a major Department of Energy facility in South Carolina, a number of sites have been used for the disposal of waste. Programs are currently underway to ensure the protection of ground water resources at SRP. The groundwater protection programs include flow system monitoring and characterization, and remedial action assessment and implementation. As part of these programs, groundwater flow and solute transport within the General Separations Area of SRP were simulated by numerical models. Modeling was conducted on two scales: a three-dimensional model simulating regional groundwater flow was constructed for the General Separations Area, and two local solute transport models were developed for the F and H Area seepage basins, two waste sites within the General Separations Area. In the regional flow model, the confining units used leakage functions yielding an overall quasi-three-dimensional approach. Hydraulic parameters were estimated by the Gauss-Newton nonlinear least-squares method. The parameter estimation algorithm used 50 observed water levels distributed areally and vertically in the model domain as targets for the calibration model. The results agreed well with values obtained by other methods. In the local solute transport model at the F and H Areas, a quasi-three-dimensional approach was again employed using leakance coefficients to represent the two confining units. The estimated hydraulic parameters showed excellent agreement with results from other methods. The model showed that regional flow phenomena can be preserved in reduced scale models by extracting hydraulic boundaries and parameters form the regional flow model to accurately analyze contaminant migration during a two-year response time. (Author's abstract)
W88-07956

WASTE MIGRATION IN SHALLOW BURIAL SITES UNDER SATURATED FLOW CONDITIONS,
Georgia Inst. of Tech., Atlanta. Nuclear Engineering and Health Physics Program.
G. G. Eicholz, and J. Whang.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010187. Price codes: A02 in paper copy, A01 in microfiche. Report No. DP-MS--87-25, (1987). 7 p, 9 fig, 5 tab, 11 ref. DOE Contract No. DE-AC09-76SR00001.

Descriptors: *Path of pollutants, *Unsaturated flow, *Shallow burial sites, *Land disposal, *Waste disposal, Leaching, Radioactive tracers, Soil columns, Flow profiles, Cesium radioisotopes, Iodine radioisotopes, Barium radioisotopes, Hysteresis.

Unsaturated conditions prevail in many shallow land burial sites, both in arid and humid regions. Unless a burial site is allowed to flood and possibly overflow, a realistic assessment of any migration scenario must take into account the conditions of unsaturated flow. These are more difficult to observe and to model, but introduce significant changes into projected rates of waste leaching and waste migration. Column tests have been performed using soils from the Southeastern coastal plain to observe the effects of varying degrees of 'unsaturation' on the movement of radioactive tracers. The moisture content in the columns was controlled by maintaining various levels of hydrostatic suction on soil columns whose hydrodynamic characteristics had been determined carefully. Tracer tests, employing 137-Cs, 131-I, and 133-Ba were used to determine migration profiles and to follow their movement down the column for different suction values. A calculational model has been developed for unsaturated flow and seems to match the observations fairly well. It is evident that a full description of migration processes must take into account the reduced migration rates under unsaturated conditions and the hysteresis effects associated with wetting-drying cycles. (Author's abstract)
W88-07964

ROCKWELL HANFORD OPERATIONS ENVIRONMENTAL SURVEILLANCE: ANNUAL REPORT, CALENDAR YEAR 1986,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
R. E. Elder, G. W. Egert, A. R. Johnson, and W. L. Osborne.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010398. Price codes: A06 in paper copy, A01 in microfiche. Report No. RHO-HS-SR--86-13P, May 1987. 140 p, 4 fig, 21 ref, 10 append. DOE Contract No. DE-AC06-77RL01030.

Descriptors: *Environmental protection, *Path of pollutants, *Pollutant identification, *Radioactive wastes, *Environmental impact, Sampling, Water analysis, Sediments, Soil analysis, Radiation, Waste disposal, Air pollution.

Environmental surveillance of the Separations Area of Hanford is performed by Rockwell Hanford Operations (Rockwell) to assess and control the impacts of operations. This involves sampling and analysis from the major environmental pathways of exposure to onsite workers. Surveillance activities include sampling and analysis of ambient air, surface water, groundwater, sediments, soil, and biota. External radiation measurements and radiological surveys of waste disposal sites, radiological control areas, and roads are also performed. The 1986 activities and data are summarized in this document. (Lantz-PTT)
W88-07970

IN SITU MONITORING OF ORGANICS,
Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV. Nevada Test Site.
For primary bibliographic entry see Field 7A.
W88-07977

SOIL GAS SENSING FOR DETECTION AND MAPPING OF VOLATILE ORGANICS,
Nevada Univ., Las Vegas. Environmental Research Center.
For primary bibliographic entry see Field 7A.
W88-07979

5C. Effects Of Pollution

FISH COMMUNITY STRUCTURE IN RELATION TO ACIDITY IN THREE NOVA SCOTIA RIVERS,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
G. L. Lacroix.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 12, p 2908-2915, December 1987. 4 fig, 4 tab, 45 ref.

Descriptors: *Water pollution effects, *Acid rain effects, *Fish populations, *Population density, *Distribution patterns, *Acid streams, *Hydrogen ion concentration, Salmon, Minnows, Eel, Sucker, Nova Scotia, Canada.

The occurrence, density, and age-class structure of endemic fish species were compared over a period of 24 months in three Nova Scotia streams of differing pH. The absence of acid-sensitive species and very low densities of fish characterized the stream with a pH range of 4.5-5.0. Fish densities were lower in the stream with a pH range of 4.7-5.4 than in the stream with a pH range of 5.6-6.3. Juvenile salmon and cyprinids were the most abundant species in the least acidic stream. Their densities were considerably lower in the with pH levels of 4.7-5.4, and the young age-classes of the cyprinid species were rare or absent. Both salmon and cyprinids were absent in the most acidic stream. In contrast, American eels were most abundant in the two streams with pH levels less than 5.5, and they accounted for an increasingly large proportion of the fish biomass at the lowest pH levels. White sucker was the most abundant species at the lowest pH levels, but its contribution to biomass was unimportant because of the absence of most age-classes older than 0+. Several other species found in the most acidic stream were not very abundant, and old age-classes were usually absent for most of these. The observed distributional patterns were considered to be mostly pH related. (Author's abstract)
W88-06821

GROWTH AND PHYSIOLOGICAL CONDITION OF BLACK DUCKS REARED ON ACIDIFIED WETLANDS,
Dept of Animal Science, Cook College, Rutgers - The State University, New Brunswick, NJ 08903.
B. A. Rattner, G. M. Haramis, D. S. Chu, C. M. Bunck, and C. G. Scanes.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 12, p 2953-2958, December 1987. 2 fig, 3 tab, 36 ref.

Descriptors: *Acid rain, *Growth rates, *Ducks, *Wetlands, *Acidic water, *Experimental data, Biochemical tests, Nutrition, Survival, Physiological ecology, Animal diseases.

Acid deposition has been identified as one of several possible factors contributing to the decline of

some waterfowl populations in North America. In an effort to examine the effects of acidification on black duck (Anas rubripes) recruitment, growth and physiological condition were monitored in ducklings foraging for a 10-day trial (days 10-20 of life) on acidified (pH 5.0) and circumneutral (pH 6.8) fish-free emergent wetlands. Acidification of these wetlands suppressed phytoplankton and algal growth, and reduced invertebrate biomass. Ducklings maintained on acidified wetlands grew poorly compared with ducklings reared on circumneutral wetlands, as evidenced by lower final body weight and culmen and tarsus length. Plasma growth hormone concentration was elevated and triiodothyronine levels were lower in stunted ducklings, in part substantiating impairment of growth-regulating processes. Ducklings exhibiting poor growth tended to have lower hematocrit, lower plasma protein, glucose, and cholesterol concentrations, and higher uric acid levels, presumably reflecting alterations in metabolism and development due to inanition. These findings suggest that acid deposition may lower food production in wetlands and ultimately impair duckling growth, condition, and survival. (Author's abstract)
W88-06823

WATERBORNE NON-A, NON-B HEPATITIS,
Fogarty International Center, National Institutes of Health, Bethesda, MD.
V. Ramalingaswami, and R. H. Purcell.
The Lancet LANAAI, Vol. I, No. 8585, March 12, 1988. 36 ref.

Descriptors: *Hepatitus, *Public health, *Water quality control, *Non-A, non-B hepatitis, *Viruses, *Human diseases, *Epidemics, *Drinking water, *Feces, Histology, Liver, Spatial distribution, Immunization.

Waterborne non-A, non-B hepatitis (NANB) is responsible for outbreaks of hepatitis with a predilection for young adults. The disease is usually mild, except in pregnant women, who have a high case-fatality rate from fulminant hepatic failure. Diagnosis is largely based on the epidemiological findings of fecal contamination of drinking water and serological exclusion of hepatitis A and B virus infection. Histological features of liver biopsy specimens are characteristic and virus-like particles in the stool are aggregated by antibody present in acute and convalescent phase sera of the test subject. NANB is widespread in India and several countries of South-East Asia; it is increasingly recognized in Africa and may occur in Latin America. Control measures include provision of clean water supplies, safe disposal of human excreta, and sound personal and food hygiene practices. Passive immunization with immunoglobulin derived from healthy donors resident in the countries affected by the disease may protect vulnerable groups. (Author's abstract)
W88-06846

PETROLEUM HYDROCARBONS IN THE MARINE BIVALVE VENUS VERRUCOSA: ACCUMULATION AND CELLULAR RESPONSES,
Science Dept., Univ. of Malta, Msida, Malta.
For primary bibliographic entry see Field 5B.
W88-06848

TEMPORAL VARIABILITY AND THE RELATIONSHIP BETWEEN BENTHIC MEIOFAUNAL AND MICROBIAL POPULATIONS OF A NATURAL COASTAL PETROLEUM SEEP,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
P. A. Montagna, J. E. Bauer, J. Toal, D. Hardin, and R. B. Spies.
Journal of Marine Research JMMRAO, Vol. 45, No. 3, p 761-789, August 1987. 14 fig, 6 tab, 61 ref.
US Department of Interior Contract 14-12-0001-30159. USDOE Contract W-7405-ENG-48.

Descriptors: *Petroleum seeps, *Oil pollution effects, *Water pollution effects, *Benthic fauna, *Population density, Population exposure, Aquatic animals, Benthos, Fauna, Santa Barbara Channel, California, Nematodes, Bacteria, Copepods.

Previous studies of the Isla Vista petroleum seep in the Santa Barbara Channel found much higher abundances of macrofauna and concentrations of adenosine phosphate (ATP) in sediments near petroleum seepage compared to those from nonseep areas. To further assess the possible effect of petroleum on organisms at the base of benthic food webs, population abundances of meiobenthos and their suspected microbial food (bacteria and diatoms) were measured biweekly at three stations with differing petroleum exposure. Determinations of suspended particulate matter and the abundance and gut contents of juvenile fishes were also made at seep and nonseep stations. Nematodes and bacteria had higher abundances in areas of active petroleum seepage than in areas of moderate seepage (within 20 m) or no seepage (1.4 km away). Bacterial productivity (based on frequency of dividing cells) was 340% greater in sediments from areas of active seepage compared to those from a nonseep station. Sediments within the seep, but away from active seepage, had rates of bacterial productivity 15 times greater than a nonseep comparison site. Densities of harpacticoid copepods and their probable principal food, diatoms, were not affected by petroleum seepage. Suspended organic matter caught in settling traps was not different between seep and nonseep stations. In addition, there was no evidence that predation pressure by juvenile fish on meiofauna was different between stations. The higher bacterial biomass and productivity in areas of petroleum seepage are consistent with the hypothesis that petroleum carbon is available for assimilation by sediment bacteria. The enhanced level of microbial carbon associated with the petroleum seep is available for consumption by benthic invertebrates and could explain the higher abundances of macrofauna and meiofauna found there. (Author's abstract)
W88-06866

EFFECTS OF A TANKER ACCIDENT AND AN OIL BLOWOUT IN BRISTOL BAY, ALASKA, ON RETURNING ADULT SOCKEYE SALMON (ONCORHYNCHUS NERKA) - A SIMULATION STUDY,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
N. J. Bax.
Marine Environmental Research MERSDW, Vol. 22, No. 3, p 177-203, 1987. 9 fig, 3 tab, 41 ref.
National Marine Fisheries Service Contract WASC-83-00134.

Descriptors: *Water pollution effects, *Oil pollution, *Salmon, *Oil, *Simulation, *Oil spills, Fuel, Oil tankers, Bristol Bay, Alaska, Fish, Mortality, Fish migration.

The effects of a tanker accident releasing 34,000 tons of diesel fuel and a blowout releasing 3000 tons/day of crude oil on adult sockeye salmon returning through Bristol Bay, Alaska, were simulated. Parameters in the simulation were chosen to maximize possible effects of the oil. Mortalities from the tanker accident were predicted to range from 2% to 18% of the adults passing through the spill area or 1% to 5% of the total returning population. From 3% to 7% of the adults surviving migration through the spill area, or 1% to 2% of the total population, could be tainted at or above 0.6 ppm of hydrocarbons in the flesh. As many as 30% of the adults returning to fishing grounds closest to the spill area could be tainted. Effects of the blowout in returning salmon were less severe than those of the tanker accident, with mortalities reaching a maximum of 0.2% of the adults passing through the area of the blowout, and no tainting predicted above 0.6 ppm. (Author's abstract)
W88-06871

PHYSIOLOGICAL RESPONSES OF MYTILUS EDULIS DURING CHRONIC OIL EXPOSURE AND RECOVERY,
Institute for Marine Environmental Research, Plymouth (England).
J. Widdows, P. Donkin, and S. V. Evans.
Marine Environmental Research MERSDW, Vol. 23, No. 1, p 15-32, 1987. 4 fig, 5 tab, 26 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Mussels, Mytilus, Mollusks, Hydrocarbons, Bioaccumulation, Feeding rates, Growth rates, Absorption, Uptake.

Physiological responses of mussels Mytilus edulis were determined following 8 months' exposure to two oil concentrations (28 and 125 micrograms/liter total hydrocarbons) and during the process of recovery. There was a significant inverse relationship between the performance of Mytilus edulis, measured in terms of scope for growth, and the concentration of aromatic hydrocarbons accumulated in the body tissues. The marked reduction in scope for growth of oil exposed mussels was primarily due to a reduction in feeding rate and food absorption efficiency. Recovery of physiological responses was coupled to the depuration of aromatic hydrocarbons from the body tissues. Mussels exposed to high-oil concentrations recovered more rapidly than those exposed to low-oil concentrations, both in terms of depuration and scope for growth, and there was evidence of 'catch-up' growth. Recovery of mussels from both oil conditions was complete after approximately 55 days. (Author's abstract)
W88-06872

BIOENERGETIC RESPONSES OF THE MARINE BIVALVE VENUS VERRUCOSA ON LONG-TERM EXPOSURE TO PETROLEUM HYDROCARBONS,
The Department of Science, University of Malta, Msida, Malta.
V. Axiak, and J. J. George.
Marine Environmental Research MERSDW, Vol. 23, No. 1, p 33-47, 1987. 2 fig, 3 tab, 34 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Mollusks, Feeding rates, Absorption, Oxygen requirements, Ammonia excretion, Ammonia, Growth, Nitrogen, Oxygen, Stress.

A number of physiological responses of the bivalve Venus verrucosa on exposure to low levels of water accommodated fractions of Kuwait crude oil (100 micrograms/liter) for 145 days were investigated in the laboratory. Such exposure led to significant decreases in clearance or feeding rates and in the food absorption efficiencies, as well as enhanced oxygen consumption and ammonia excretion. The integration of such physiological responses to assess the scope for growth, as well as the oxygen to nitrogen ratio, indicated that such exposure led to a significant drop in the energy available for somatic growth and reproduction and enhanced protein catabolism (this being indicative of stressed conditions). These results were also confirmed by significant reductions in several body condition indices of the exposed bivalves relative to the controls. Any significant prolonged reduction in the scope for growth, such as that reported for Venus verrucosa in the this experiment, may lead to a deterioration in the ecological fitness of the population as a whole. (Wood-PTT)
W88-06873

TEMPORAL CHANGES IN AHH AND SOD ACTIVITIES IN FERAL SPOT FROM THE ELIZABETH RIVER, A POLLUTED SUB-ESTUARY,
Virginia Inst. of Marine Science, Gloucester Point.
M. H. Roberts, D. W. Sved, and S. P. Felton.
Marine Environmental Research MERSDW, Vol. 23, No. 2, p 89-101, 1987. 1 fig, 2 tab, 42 ref.

Descriptors: *Heavy metals, *Hydrocarbons, *Water pollution effects, *Fish, *Enzymes, *Fish physiology, *Elizabeth River, Ware River, Seasonal variation, Temporal distribution, Pollutants, Estuaries.

Aryl hydrocarbon hydroxylase (AHH) and superoxide dismutase (SOD) activities were measured in young-of-the-year feral fish collected between June and October 1985 from three stations in the highly polluted Elizabeth River and from one reference station in the relatively unpolluted Ware River. AHH activity increased to a peak in July and September, and then declined in October,

whereas SOD activity increased throughout the study period. Both AHH and SOD activities were higher in fish from the Elizabeth River stations than those from the Ware River. Fish condition factor was measured in all fish. These values were lower than the values found in the literature for a site in South Carolina, but did not differ among the four stations sampled in this study. (Author's abstract)
W88-06874

OCCURRENCE OF HYDROCARBONS AND HISTOPATHOLOGICAL ABNORMALITIES IN OYSTERS FOR SEVEN YEARS FOLLOWING THE WRECK OF THE AMOCO CADIZ IN BRITTANY (FRANCE),
Laboratoire de Biochimie, Faculte de Medecine BP-815, 29285 Brest, Cedex, France.
F. Berthou, G. Balouet, G. Bodennec, and M. Marchand.
Marine Environmental Research MERSDW, Vol. 23, No. 2, p 103-133, 1987. 11 fig, 5 tab, 73 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Oysters, *Oil spills, *Hydrocarbons, *Brittany, Mollusks, Oil, France, Oyster tissues, Sediments, Histopathology, Decontamination, Diseases.

A study of the main oyster areas polluted by the Amoco Cadiz oil spill (Abers, Baie de Morlaix) was carried out between 1978 and 1985 by chemical analyses (mainly aromatic hydrocarbon determinations) and histopathological observations of lesions in the digestive tracts and gonads of oysters. The hydrocarbon content in oyster tissues was monitored and analyzed by UV spectrofluorimetry, and gas liquid chromatographic techniques. Seven years after the Amoco Cadiz wreck, the oysters sampled in the Aber-Benoit and in the Baie de Morlaix (Carantec) were still polluted with residual aromatic hydrocarbons, corresponding, respectively, to about five and two times the values from an unpolluted site (Baie de Saint-Brieuc). Since petroleum residues are buried in anaerobic sediments, especially in the Abers areas, they are expected to persist and accordingly may contaminate oysters for several more years. Depuration kinetics of contaminated flat and Pacific oysters form the heavily polluted zones (Abers, Carantec) were studied and compared with those of healthy oysters transplanted in the same areas. The decontamination rates of oysters after transfer to a clean environment were heavily dependent on the duration of oil exposure. Necrosis and inflammation were the most significant and noticeable changes occurring during the first months after the pollution. Atrophy of the gonadal cells was detected in the oysters from the Abers only during the first six months of the study. No neoplastic or parasitic diseases were related to the oil spill. (Author's abstract)
W88-06875

HISTOCHEMICAL OBSERVATIONS ON THE SALMONIDS SALMO SALAR L. AND SALMO TRUTTA L. AND THE EPHEMEROPTERANS BAETIS RHODANI (PICT.) AND ECDYONURUS VENOSUS (FABR.) FOLLOWING A SIMULATED EPISODE OF ACIDITY IN AN UPLAND STREAM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
C. P. McCahon, D. Pascoe, and C. McKavanagh.
Hydrobiologia HYDRB8, Vol. 153, No. 1, p 3-12, October 9, 1987. 14 fig, 3 tab, 51 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Acidic water, *Fish, *Aluminum, Trout, Salmon, Streams, Mayflies, Aquatic insects, Insects.

Salmon, brown trout, and mayflies were exposed to acid and aluminum in a stream to explain any association between mucus secretion and formation of an aluminum coagulation film on gills. The acid zone of the stream had a pH of 4.26 and a negligible aluminum concentration of 0.052 mg/liter. The acid plus aluminum zone had a pH of 5.02 and an aluminum concentration of 0.35 mg/liter. No control animals were stained upon application of Alician blue (pH 2.5)/periodic acid-Schiff reagent for mucus or Solochrome azurine (pH 5) for aluminum. Mayflies in the acid zone showed no mucus formation or aluminum absorption upon staining. Fish in the acid zone showed no evidence of aluminum upon staining, but increased mucus formation on gills was noted. Animals in the acid plus aluminum zone showed the greatest mortality after the 24-hour exposure: 86.7% of salmon, 50.5% of trout, and 23.5% and 14.3% for the two mayfly groups. Both fish species showed extensive staining of aluminum-positive material and of mucus on the gills. Mayflies were coated with aluminum but did not produce mucus. Mean aluminum concentrations of digested fish gills were 2950 and 3050 microgram/gram dry weight for trout and salmon, respectively, and 1200 and 3175 microgram/gram dry weight for whole specimens of the two mayflies. (Cassar-PTT)
W88-06891

RESISTANCE AND VIABILITY OF SALVELINUS FONTINALIS GAMETES AT VARIOUS PH (RESISTANCE ET VIABILITE DES GAMETES D'OMBLE DE FONTAINE, SALVELINUS FONTINALIS, A DIFFERENTS PH),
Laval Univ., Quebec. Dept. de Biologie.
M. St.-Pierre, and G. Moreau.
Hydrobiologia HYDRB8, Vol. 153, No. 2, p 139-148, October 20, 1987. 4 fig, 4 tab, 34 ref.

Descriptors: *Water pollution effects, *Fish reproduction, *Acidic water, *Acid rain effects, *Eggs, *Sperm, *Trout, Gametes, Lakes, Hydrogen ion concentration.

The lower pH limit for successful fertilization of brook trout eggs was about 4.5, the exact point depending upon the types of acid and origin of parental stock. The proportion of motile spermatozoa in a sulfuric acid solution decreased with decreasing pH from 75-90% at pH 5.0 to 20-30% at pH 4.0, to 10-20% at pH 3.5, and to zero at pH 3.0. Motility was greater in the presence of strongly dissociated acid (sulfuric) than in a weakly dissociated acid (acetic). In acetic acid of pH 4 sperm neutralized 5 times as many hydrogen ions as in sulfuric acid. At the same pH level, the proportion of motile spermatozoa was less in the soft acid water of Lac Ovide than in the harder, less acid water of Lac Noir. Spermatozoa from fish collected in acid lakes were more resistant to acidity than sperm from fish of a nearly neutral lake, suggesting a genetic adaptation to acid water. Survival of eggs was greater at pH 4.5 (>97%) than at pH 4.0 (87%). Water absorption by eggs decreased below pH 5.2 or 4.5 for eggs collected from nearly neutral or acid lakes, respectively. (Cassar-PTT)
W88-06896

ALGAL-PERIPHYTON POPULATION AND COMMUNITY CHANGES FROM ZINC STRESS IN STREAM MESOCOSMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. B. Genter, D. S. Cherry, E. P. Smith, and J. Cairns.
Hydrobiologia HYDRB8, Vol. 153, No. 3, p 261-275, October 30, 1987. 4 fig, 3 tab, 41 ref, append.

Descriptors: *Water pollution effects, *Streams, *Zinc, *Population dynamics, *Algae, *Heavy metals, Metals, Species composition, Chlorophyta, Cyanophyta, Seasonal variation, Diatoms.

Three treatments of zinc (0.05, 0.5, 1.0 mg Zn/liter) were applied to established algal communities in outdoor, flow-through stream mesocosms for 30 days each in spring, summer, and fall of 1984. Diatoms dominated the control stream in all seasons. In the 0.05 mg/liter treatment certain diatom taxa were more abundant than in the control stream in all seasons, and a filamentous green algae was present in summer and fall. The 0.5 mg/liter treatment was characterized by a different diatom population and filamentous green alga in fall. The 1.0 mg/liter treatment produced dominance by unicellular green algae in all seasons and by a filamentous blue-green algae in summer. A similarity index indicated that Zn-stressed samples generally became less similar to control samples as Zn concentration increased from 0.05 to 1.0 mg/liter. Total biovolume-density of all taxa responded slower than individual taxa in spring and failed to distinguish between Zn treatments in summer and fall. Zinc bound to periphyton was more reliable than total Zn in water for indicating Zn stress. Although the EPA criterion level for Zn is 0.047 mg/liter, the algal community composition changed significantly at the 0.05 mg/liter treatment. (Cassar-PTT)
W88-06900

MICRONUTRIENT AND PHOSPHORUS LIMITATION OF PHYTOPLANKTON ABUNDANCE IN GEM LAKE, SIERRA NEVADA, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. L. Stoddard.
Hydrobiologia HYDRB8, Vol. 154, p 103-111, November 16, 1987. 6 fig, 3 tab, 44 ref. Water Resources Center, Davis, CA, Grant UCAL-WRC-W-619.

Descriptors: *Lakes, *Alpine lakes, *Limiting nutrients, *Nutrients, *Phosphorus, *Phytoplankton, Gem Lake, California, Algal growth, Iron, Copper, Nitrogen, Trace metals, Metals, Chlorophyll.

Nutrient addition experiments were conducted during the ice-free seasons of 1983 and 1984 in Gem Lake, an alpine lake in California. The lake has a surface area of 2.77 ha and a mean depth of 3.4 m. The phytoplankton community is largely coccoid green algae and diatoms. Algal biomass was limited by phosphorus in combination with iron or copper. Phosphorus additions were always required to stimulate growth, but phosphorus additions alone did not increase growth. Simultaneous additions of phosphorus and iron resulted in increased levels of chlorophyll, particulate carbon, particulate nitrogen, and particulate phosphorus. Simultaneous additions of phosphorus and copper resulted in increases in chlorophyll, particulate nitrogen, and particulate phosphorus, but not in particulate carbon. Seasonal particulate N:P ratios suggested that simultaneous micronutrient and phosphorus limitation exists throughout the summer when nutrient and biomass levels are low; limitation by phosphorus alone may appear in fall and spring when biomass and major ion concentrations increase dramatically. (Cassar-PTT)
W88-06905

EFFECT OF AGRICULTURE ON THE PRIMARY PRODUCTION IN LAKE BESKIE (POLAND) AS RECORDED IN THE STRATIGRAPHY OF FOSSIL PIGMENTS,
Department of Ecology and Freshwater Biology, Academy of Agriculture and Technology, 10-957 Olsztyn, Poland.
M. Rybak.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 21-26, January 8, 1988. 3 fig, 40 ref.

Descriptors: *Water pollution effects, *Lakes, *Agriculture, *Primary productivity, Lake Beskie, Poland, Paleolimnology, Sediments, Bottom sediments, Lake sediments, Phosphorus, Fertilizers, Eutrophication, Chlorophyll.

Analysis of fossil pigments deposited in the bottom sediments of Lake Beskie was used to assess changes in the primary productivity during the past 40 years. Three distinct periods were identified. The 3-13 cm layer corresponded to an intensification of plant production during 1945-1975. In the erosive phase (A1, 11-13 cm) increased fertilizer use caused an increase in primary production. In phase A2 (3-10 cm) eutrophication occurred. First, primary production became stable, then increased due to reduction reactions and phosphorus liberation. The resulting high oxygen deficits were characterized by development of photosynthetic bacteria of the genus Chlorobium. In phase B (3-4 cm) primary production rapidly decreased, reflecting considerable intensification of reduction in the hypolimnion and maximal development of blue-green algae. This correlated with the introduction of

organic fertilization with manure. Although manure use increased the amount of available soluble phosphorus, it improved the soil's ability to absorb nutrients. Consequently, nutrient leaching decreased and so did primary production. (Cassar-PTT)
W88-06910

GROWTH IN A FRESHWATER SNAIL UNDER LABORATORY CONDITIONS IN RELATION TO EUTROPHICATION,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
J. Dorgelo.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 125-127, January 15, 1988. 2 fig, 13 ref.

Descriptors: *Lakes, *Snails, *Eutrophication, *Growth rate, Lake Maarsseveen, Netherlands.

Shell growth in the snail Potamopyrgus jenkinsi (Prosobranchia, Hydrobiidiae) was measured under laboratory conditions for 200 days. Snails collected from two lakes of different trophic status were kept in water and sand from their own environment and in water and sand from the other lake. The lakes were meso-oligotrophic Lake Maarsseveen I and eutrophic Lake Maarsseveen II in the center of the Netherlands. Growth was faster in the environment of the more eutrophic lake, regardless of the origin of the snails, particularly for the smallest size class. (Cassar-PTT)
W88-06916

NUISANCE BIOMASS LEVELS OF PERIPHYTIC ALGAE IN STREAMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, J. M. Jacoby, R. R. Horner, and M. R. Seeley.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 161-168, January 15, 1988. 4 fig, 3 tab, 21 ref. National Science Foundation Grant No. CEE-8304731.

Descriptors: *Streams, *Algae, *Periphyton, Phosphorus, Aesthetics, Biomass, Water quality, Chlorophyll.

Relative coverage of filamentous periphytic algae increased with chlorophyll a biomass on natural substrata in 22 northwestern United States and Swedish streams. A biomass range of 100-150 mg chlorophyll a/sq m may represent a critical level for an aesthetic nuisance; below those levels, filamentous coverage was < 20%. Other indices of water quality (dissolved oxygen content and measures of benthic macroinvertebrate diversity) were apparently unaffected by periphytic biomass or filamentous coverage in these streams. Neither was biomass related to limiting nutrient content (soluble reactive phosphorus) as had been observed in previous experiments using bare rocks in streams and slides in artificial channels. Ambient soluble reactive phosphorus concentration may not be a useful predicter of periphyton accrual on natural substrates, due to uptake and recycling of P throughout the stream and undetermined losses such as sloughing and grazing. (Author's abstract)
W88-06917

WATER HYACINTH PRODUCTIVITY AND DETRITUS ACCUMULATION.
For primary bibliographic entry see Field 2H.
W88-06918

EFFECT OF CHRONIC EXPOSURE TO CADMIUM AND COPPER ON ASELLUS AQUATICUS (L.) (CRUSTACEA, ISOPODA),
Dipt. Genetica, Biologia generale e molecolare, Via Mezzocannone, 8-80134 Napoli, Italy.
M. D. Giudici, L. Migliore, C. Gambardella, and A. Marotta.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 265-269, January 22, 1988. 3 fig, 2 tab, 11 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Cadmium, *Copper, *Crustaceans, Isopods, Invertebrates, Metals, Sublethal effects, Toxicity, Growth rates, Reproduction, Juvenile growth stage, Embryonic growth stage.

The effects of chronic exposure to 5 microgram/liter of cadmium or copper on the crustacean isopod Asellus aquaticus (L.) were studied by analyzing survival and body growth in the first stages of the life-cycle and by determining fecundity and survival of embryo-bearing females. Cadmium exposure caused the highest death rates in individuals exposed during both embryonic and juvenile stages, followed by those exposed in the embryonic stage only, then those exposed in the juvenile stage only. This indicates that cadmium is more toxic during the embryonic stage than in the juvenile stage. Copper exposure also caused the highest death rates in those exposed during both embryonic and juvenile stages, but those exposed only as juveniles had higher death rates than those exposed only as embryos. This indicates that copper is more toxic during the juvenile stage than during the embryonic stage. The ST50 (survival time of 50% of individuals tested) confirmed the above results: cadmium treatment--during embryonic development, 37 days; during juvenile development, 45 days; during both embryonic and juvenile development, 18 days; copper treatment--during embryonic development, 47 days; during juvenile development, 33 days; during both embryonic and juvenile development, 15 days. In a 60-day growth study, cadmium-treated individuals showed an impressive increase in body size starting from day 30; however, copper-treated individuals showed depressed growth starting at day 30. Embryo-bearing female survival and fecundity were significantly reduced by Cd but were not affected by Cu. (Cassar-PTT)
W88-06920

RESPONSES OF ESTUARINE MACROFAUNA COLONIZING SEDIMENTS CONTAMINATED WITH FENVALERATE,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
M. E. Tagatz, R. S. Stanley, G. R. Plaia, and C. H. Deans.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 1, p 21-25, January 1987. 4 tab, 11 ref.

Descriptors: *Water pollution effects, *Fenvalerate, *Pyrethrins, *Insecticides, *Estuarine environment, *Benthic fauna, *Aquatic animals, *Sand, Mollusks, Chordates, Annelids, Arthropods, Animal populations, Biological studies, Food chains.

Macrobenthic animal communities that colonized uncontaminated and fenvalerate-contaminated sand (0.1, 1 and 10 micrograms/g dry weight, nominal) in boxes placed for 8 weeks in an estuary were compared to assess effects of fenvalerate on community structure. As much as 27% of initial concentrations of this synthetic pyrethrin persisted in sediment at the end of the test. The average number of species (35.6) in communities in five replicates exposed to 10 micrograms/g was significantly less than that in the control (47.8) and lower concentrations (45.0 and 46.2). Of the dominant phyla collected (Annelida, Mollusca, Chordata and Arthropoda), abundance of chordates only (primarily lancelets, Branchiostoma caribaeum) was reduced by 10 micrograms fenvalerate/g. Biological indices applied to the data showed the greatest structural differences for communities exposed to the highest concentrations, but these did not differ substantially from those for the control. Effective concentrations for exposure via the sediment was five orders of magnitude greater than that for waterborne exposure determined in earlier benthic community studies. (Author's abstract)
W88-06923

AVOIDANCE BEHAVIOR OF MALLARDS AND NORTHERN BOBWHITE EXPOSED TO CARBOFURAN-CONTAMINATED FOOD AND WATER,
Department of Animal Science, Michigan State University, East Lansing, MI 48824-1225.
D. W. Kononen, J. R. Hochstein, and R. K. Ringer.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 1, p 41-50, January 1987. 11 tab, 11 ref.

Descriptors: *Ducks, *Waterfowl, *Toxicity, *Animal populations, *Carbofuran, *Pesticides, *Pollutants, *Water pollution effects, *Animal behavior, Population exposure, Motivation, Food habits, Diets.

Food and water avoidance experiments were conducted on mallards (Anas platyrhynchos L.) and northern bobwhite (Colinus virginianus L.) exposed to a range of dietary carbofuran concentrations. A dietary avoidance concentration 50 (analogous to an LC50) was calculated for each avoidance experiment. This statistic describes the dietary toxicant concentration threshold at which, when exceeded, exposed animals are likely to discriminate between untreated and treated feed or water. The food avoidance concentration 50s (FAC50s) for mallards and bobwhite were 10 and 159 ppm, respectively. The water avoidance concentration 50 (WAC50) for mallards was 3 ppm. For bobwhite the WAC50 for carbofuran was estimated to exceed 50 ppm. (Author's abstract)
W88-06924

IN SITU VARIATIONS IN OYSTER MUTAGENICITY AND TISSUE CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W88-06925

SENSITIVITY ANALYSIS OF POPULATION GROWTH RATES ESTIMATED FROM CLADOCERAN CHRONIC TOXICITY TESTS,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
J. S. Meyer, C. G. Ingersoll, and L. L. McDonald.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 2, p 115-126, February 1987. 6 fig, 2 tab, 28 ref.

Descriptors: *Toxicity, *Daphnia, *Animal populations, *Bioassay, *Heavy metals, *Population exposure, Copper, Cadmium, Sensitivity analysis, Aquatic animals, Survival, Reproduction, Statistics.

Four variables -- mean brood size, day of first reproduction, longevity and per capita rate of increase (r) -- were compared in four 70-d chronic toxicity tests in which Daphnia pulex were exposed to cadmium or copper in continuous and pulsed exposures. Is the population-level variable (r) more sensitive that the three organism-level variables (mean brood size, day of first reproduction and longevity) as an indicator of toxicant stress. Two variables were regarded as equally sensitive if, for both variable, differences between treatment and the control have statistical significance levels in the same probability range. In these four tests, none of the four variables was consistently the most sensitive. The sensitivity of r was evaluated by simulating shorter test durations, delays in reproduction and less frequent observation schedules. Simulated test durations of less than 21 d produced biased underestimates of r and increased coefficients of variation of the estimates of r relative to the 70-d values; simulated 1- and 2-d delays in reproduction also produced biased underestimates of r. However, estimates of r computed for a simulated Monday-Wednesday-Friday observation schedule did not differ significantly from estimates of r computed for a daily observation schedule. The authors conclude that, although the estimator of per capita rate of increase is not always the most sensitive statistic that can be computed from cladoceran chronic toxicity test data, it can be useful for evaluating apparently conflicting effects of pollutants on survival and reproduction, as occurred in the copper continuous-exposure toxicity test. (Author's abstract)
W88-06928

INDUCTION OF HEPATIC MICROSOMAL MONOOXYGENASE ACTIVITY IN FISH BY EXPOSURE TO RIVER WATER,
Medical Coll. of Wisconsin, Inc., Milwaukee. Dept. of Pharmacology and Toxicology.

M. J. Melancon, S. E. Yeo, and J. J. Lech.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 2, p 127-135, February 1987. 3 fig, 2 tab, 36 ref. NIEHS Aquatic Biomedical Center Grant No. ES01985, NIEHS Grant No. ES01980.

Descriptors: *Water pollution effects, *Carp, *Bullheads, *Population exposure, *Metabolism, *Toxicity, *River water, Enzymes, Fish physiology, Municipal water.

The effect on hepatic monooxygenase activity of exposing carp (Cyprinus carpio) and bullheads (Ictalurus melas) to river water was examined. Hepatic microsomal ethoxyresorufin-O-deethylase activities in fish maintained continuously in dechlorinated city water were compared with those in fish exposed to river water pumped into laboratory tanks. Monooxygenase activity increased rapidly upon exposure to river water and was significantly elevated after 3 d of exposure. When river water-exposed fish were returned to dechlorinated city water, monooxygenase activity steadily returned to pre-exposure levels. This report includes two studies using carp performed in different years, and a more limited study using bullheads. Carp captured in an adjacent river that flowed into Milwaukee Harbor had high hepatic microsomal ethoxyresorufin-O-deethylase activity when compared with carp in the laboratory tanks. Under these carefully controlled conditions, the occurrence and reversibility of environmental induction of monooxygenase activity were clearly demonstrated. (Author's abstract)
W88-06929

DETERMINATION OF UPTAKE RATE CONSTANTS FOR SIX ORGANOCHLORINES IN MIDGE LARVAE,
Ohio State Univ., Columbus. Dept. of Entomology.
For primary bibliographic entry see Field 5B.
W88-06930

COMPARISONS OF LABORATORY TOXICITY TEST RESULTS WITH RESPONSES OF ESTUARINE ANIMALS EXPOSED TO FENTHION IN THE FIELD,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
J. J. Clark, P. W. Borthwick, L. R. Goodman, J. M. Patrick, and J. C. Moore.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 2, p 151-160, February 1987. 4 fig, 1 tab, 17 ref.

Descriptors: *Population exposure, *Toxicity, *Fenthion, *Insecticides, *Estuarine environment, *Lethal limit, *Shrimp, *Minnows, *Organic pesticides, *Water pollution effects, Ecological effects, Pulse-exposure tests, Crustaceans, Fish.

Acute, lethal effects of fenthion (an organophosphate insecticide) on mysids (Mysidopsis bahia), grass shrimp (Palaemonetes pugio), pink shrimp (Penaeus duorarum) and sheepshead minnows (Cyprinodon variegatus) were determined in laboratory tests and after field applications. Exposures at four field sites ranged from short-term exposures (12 h or less) of rapidly decreasing fenthion concentrations to extended intervals (more than 72 h) with slowly increasing or decreasing fenthion concentrations. Laboratory-derived LC50s provided a reliable benchmark for predicting acute, lethal effects of fenthion on caged animals in the fields when exposures persisted for 24 h or more but overestimated the toxicity for exposures of less than 24 h. Laboratory pulse-exposure tests with rapidly changing concentrations for 12 h were predictive of the nonlethal and lethal effects observed for short-term field exposures. (Author's abstract)
W88-06931

AVOIDANCE RESPONSES OF SCHOOLING FATHEAD MINNOWS (PIMPEPHALES PROMELAS) TO A BLEND OF METALS DURING A 9-MONTH EXPOSURE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
S. I. Hartwell, D. S. Cherry, and J. C. Cairns.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 3, p 177-187, March 1987. 4 fig, 4 tab, 43 ref.

Descriptors: *Avoidance responses, *Population exposure, *Heavy metals, *Minnows, *Fish behavior, *Animal behavior, Motivation, Contaminants, Copper, Chromium, Arsenic, Selenium, Water pollution.

Avoidance of a blend of four metals (relative proportions: 1.00 copper, 0.54 chromium, 1.85 arsenic, 0.38 selenium) was determined in fathead minnows (Pimephales promelas) in a steep-gradient, laminar-flow chamber. Avoidance responses were determined seasonally during 12 months of laboratory observation for unexposed (control) and metals-exposed fish. Unexposed fish avoided very low concentrations of the blend (29 micrograms/L total metals). Fish exposed to 98 micrograms/L total metals preferred elevated concentrations equal to three times the holding exposure concentration (294 micrograms/L total metals) after 3 months of exposure, mildly avoided concentrations five times the holding exposure concentration (490 micrograms/L total metals) after 6 months of exposure and were not responsive to concentrations approaching ten times the holding exposure level (980 micrograms/L total metals) after 9 months of exposure. Activity, as measured by movements per unit time in the avoidance tests, was not affected by long-term exposure or during testing. (See also W88-06934) (Author's abstract)
W88-06933

FIELD VALIDATION OF AVOIDANCE OF ELEVATED METALS BY FATHEAD MINNOWS (PIMEPHALES PROMELAS) FOLLOWING IN SITU ACCLIMATION,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
S. I. Hartwell, D. S. Cherry, and J. C. Cairns Jr.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 3, p 189-200, March 1987. 5 fig, 5 tab, 29 ref.

Descriptors: *Population exposure, *Avoidance responses, *Heavy metals, *Arsenic, *Minnows, *Fish behavior, *Animal behavior, Motivation, Raw water, Copper, Chromium, *Selenium, Water pollution.

Avoidance of a blend of four metals (relative proportions: 1.00 copper, 0.54 chromium, 1.85 arsenic, 0.38 selenium) was determined in school of fathead minnows (Pimephales Promelas) in an artificial stream supplied with raw river water and in a natural stream. Control (unexposed) fish were tested in spring in the artificial stream and during summer in the artificial stream and a natural stream. Fish exposed continuously for 3 months to the blend of the four metals (90 micrograms/L total metals) in river water were tested during summer in the artificial and natural streams. Control fish avoided 71.1 and 34.4 micrograms/L total metals in the artificial stream in spring and summer, respectively, and 73.5 micrograms/L in the natural stream. Exposed fish did not respond to metal blends as high as 1,470 or 2,940 micrograms/L in the artificial and natural streams, respectively. Water hardness, turbidity and physical setting are implicated as possible causative factors in differences among control fish. Results are compared with those of previously report laboratory studies and the effects of pollution observed in the New River, Virginia. (See also W88-06933) (Author's abstract)
W88-06934

EFFECTS OF CHRONIC EXPOSURE TO ACIDIFIED WATER ON CHEMORECEPTION OF FEEDING STIMULI IN FATHEAD MINNOWS (PIMEPHALES PROMELAS): MECHANISMS AND ECOLOGICAL IMPLICATIONS,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
A. D. Lemly, and R. J. F. Smith.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 3, p 225-238, March 1987. 2 fig, 4 tab, 53 ref.

Descriptors: *Water pollution effects, *Acid rain effects, *Animal behavior, *Acid rain, *Population exposure, *Minnows, *Acidic water, *Hydrogen ion concentration, *Fish behavior, *Computers, *Feeding rates, *Motivation, Statistical analyses, Bioassay.

A computer-automated behavioral assay was used to assess the effects of reduced ambient pH on the response of fathead minnows to chemical feeding stimuli. The testing system quantified eight behavioral parameters based on the activity level of individual fish before and after exposure to a single-pulse dose of a feeding stimulus -- a tissue culture medium (1 ml; Eagle minimum essential medium with Earl's salts and L-glutamine) -- injected into the water circulation. Twenty-five adult minnows were tested after exposure to one of five pH levels: 8.0 (control), 7.0, 6.5, 6.0 and 5.5. Complete elimination of the feeding response occurred at pH = 6 and lower; responses at higher pH levels were not statistically different from those in the controls. Differences in water hardness (< 10 mg/L CaCO3 versus > 160 mg/L CaCO3) and duration of exposure (72 h versus 30 d) had no influence on the pattern or degree of the pH effects. Scanning electron microscopy revealed no pathological or gross morphological correlates of the behavioral changes. To test for possible recovery, minnows that did not respond at pH = 6 were placed in water of control pH (8.0) for 24 h and then rested again; a statistically significant response to the feeding stimulus was restored. These results indicate that acute and chronic sublethal levels of acidification caused a reversible impairment of chemoreception and that the impairment can occur at a relatively high pH. The toxic effect probably involves mechanical and chemical inhibition of receptor cells in the olfactory and gustatory epithelia rather than actual destruction of chemosensory tissue. In nature, reduction of pH to approximately 6.0 could impair feeding behavior and reduce food intake, fecundity and long-term survival of fathead minnow populations. The present results correspond well with environmental studies that show that fathead minnows are eliminated from natural waters when the pH levels reach 5.8 to 6.0. (Author's abstract)
W88-06935

PCB AVAILABILITY ASSESSMENT OF RIVER DREDGING USING CAGED CLAMS AND FISH,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5G.
W88-06938

ACCLIMATION TO CADMIUM TOXICITY BY WHITE SUCKERS: CADMIUM BINDING CAPACITY AND METAL DISTRIBUTION IN GILL AND LIVER CYTOSOL,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. F. Klaverkamp, and D. A. Duncan.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 275-289, April 1987. 6 fig, 2 tab, 50 ref.

Descriptors: *Population exposure, *Heavy metals, *Cadmium, *Toxicity, *Contaminants, *Lethal limit, *Acclimatization, *Fish, Mercury, Zinc, Metabolism, Enzymes, Sucker, Metallothionein, Liver, Cytosol, Bioaccumulation, Bioassay.

Juvenile white suckers (Catostomus commersoni) were exposed for one week to Cd, Zn or Hg at concentrations previously reported to produce acclimation to levels of Cd that would normally induce lethality. Cytosolic fractions from liver and gill filaments were analyzed for their capacity to bind Cd 109 and for distribution of Cu, Zn, Cd and Hg. Binding of Cd109 was increased in the cytosolic fraction (peak II), which would contain metallothionein (MTN) from liver of Cd-exposed and Zn-exposed fish, and from gill of Hg-exposed and Zn-exposed fish. This binding was also increased in the low molecular weight fraction (peak III), which would contain glutathione, from liver cytosol of all metal-exposed fish and gill cytosol of Cd-

exposed fish. Increases in Cd109 binding in peaks II and III were accompanied by decreases in Cd109 binding in high molecular weight fractions (peak I) containing enzymes from liver cytosol of all metal-exposed suckers and gill cytosol of Cd-exposed fish. Exposures to Cd, Zn or Hg produced relative increases in their respective concentrations in peaks I and II, which corresponded to the order of potency (Hg>Cd>>Zn) for inducing acclimation to Cd toxicity. Concentrations of Zn, Cu, Cd and Hg in peak II were used to provide crude estimates of MTN concentrations. Values of 314 and 33 micrograms MTN/g tissue were obtained for liver and gill, respectively, from non-exposed fish. Hg, the most potent inducer of acclimation to Cd toxicity, was the only metal that produced increased MTN concentrations and no increase in gill MTN. Further research that is required to understand the more complex relationships between acclimation to Cd toxicity and cytosolic metal-binding proteins is discussed. (Author's abstract)
W88-06939

INDUSTRIAL HALIDE WASTES CAUSE ACUTE MORTALITY OF SNOW GEESE IN OKLAHOMA,
U.S. Fish and Wildlife Service, Ecological Services, Tulsa, Oklahoma 74127.
J. K. Andreasen, and R. K. Stroud.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 291-293, April 1987. 1 tab, 5 ref.

Descriptors: *Waterfowl, *Water pollution effects, *Halides, *Lethal limits, *Contaminants, *Population exposure, *Toxicity, *Fluoride, Morbidity, Tissue analysis, Mortality.

An examination of 97 dead migratory waterfowl collected at an industrial facility showed that the birds had had severe gastric and intestinal hemorrhaging. Water samples taken at on-site waste lagoons contained 6,750 mg/L fluoride, 4,500 mg/L bromine and 1,500 mg/L boron. Brain and liver tissues contained high levels of fluoride, as compared with tissues of birds collected at a control site. From the necropsy results, the high concentration of fluoride in the water samples and the elevated tissue residues, it is concluded that the birds died from the acute fluoride poisoning. (Author's abstract)
W88-06940

USE OF RESPIRATORY-CARDIOVASCULAR RESPONSES OF RAINBOW TROUT (SALMO GAIRDNERI) IN IDENTIFYING ACUTE TOXICITY SYNDROME IN FISH: PART 1. PENTACHLOROPHENOL, 2,4-DINITROPHENOL, TRICAINE METHANESULFONATE AND 1-OCTANOL,
Environmental Research Lab., Duluth, MN.
For primary bibliographic entry see Field 5A.
W88-06941

USE OF RESPIRATORY-CARDIOVASCULAR RESPONSES OF RAINBOW TROUT (SALMO GAIRDNERI) IN IDENTIFYING ACUTE TOXICITY SYDROMES IN FISH: PART 2. MALATHION, CARBARYL, ACROLEIN AND BENZALDEHYDE,
Environmental Research Lab., Duluth, MN.
J. M. McKim, P. K. Schmieder, G. J. Niemi, R. W. Carlson, and T. R. Henry.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 313-328, April 1987. 6 fig, 5 tab, 51 ref.

Descriptors: *Trout, *Fish physiology, *Respiration, *Pesticides, *Animal diseases, *Toxicity, *Water pollution effects, *Organic compounds, *Population exposure, Uncouplers, Morbidity, Oxygen uptake, Metabolism, Fish, Model studies, Irritants, Biological membranes, Narrotics, Statistics.

An in vivo fish model was used to monitor the respiratory-cardiovascular responses of individual trout exposed to acutely toxic aqueous concentrations of two acetylcholinesterase (AChE) inhibitors, malathion and carbaryl, and two mucous membrane irritants, acrolein and benzaldehyde. The most striking changes in respiratory-cardiovascular physiology noted on malathion and carbaryl exposures were immediate decreases in oxygen utilization (U) and heart rate (HR). Ventilation volume (V sub G) increased to compensate for the lower U, but not enough to increase oxygen consumption (VO2). Blood responses in carbaryl-exposed trout differed from those in the malathion group; there were increased hematocrit (Hct) and hemoglobin (Hb) values along with an extensive drop in arterial pH (pHa) and total arterial carbon dioxide (TaCO2). A steady increase in cough rate (CR) was recorded for fish exposed to both chemicals. A moderate to low increase in V sub G and VO2 was followed at 50 to 60% survival time by sudden decreases in V sub G and VO2 until death. Ventilation rate (VR), U and HR showed a steady downward trend over the entire survival period. After the midpoint in survival time, total arterial oxygen (TaO2), TaCO2 and pH all decreased, while Hct increased steadily. Individual principal components analyses of the responses of fish exposed to the four chemicals showed that the variables were highly correlated and that the first two principal components explained 55 to 70% of the variation in the 18 parameters analyzed. Sets of toxic responses were developed to describe two new fish acute toxicity syndromes (FATS), one for AChE inhibitors and one for respiratory irritants. Of the 18 responses used in a discriminant function analysis, CR, VO2, TaO2, pHa and U were the best discriminators in predicting the correct FATS for each fish. (See also W88-06941) (Author's abstract)
W88-06942

ROOT ELONGATION METHOD FOR TOXICITY TESTING OF ORGANIC AND INORGANIC POLLUTANTS,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 5A.
W88-06947

D-2-ETHYLHEXYLPHTHLALATE INHIBITS THE HATCHING OF FROG EGGS AND IS BIOACCUMULATED BY TADPOLES,
Lund Univ. (Sweden). Dept. of Ecology.
P. Larson, and A. Thuren.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 6, p 417-422, June 1987. 4 fig, 1 tab, 24 ref.

Descriptors: *Hatching, *Phthalates, *Eggs, *Frogs, *Bioaccumulation, *Water pollution effects, Population exposure, Bottom sediments, Uptake rates, Tadpoles, Esters, Amphibians, Organic compounds.

Frog eggs were exposed to di-2-ethylhexylphthalate (DEHP) 10 to 800 microgram/gm sediment) added to the sediment in laboratory model systems. The number of successful hatchings decreased as the DEHP concentration was increased. In tadpoles, the uptake was concentration-dependent. The phthalate ester was transported from the sediment to the water, and the extent of the transport was governed by levels of DEHP in the sediment. The results show that the reproduction of frogs may be negatively affected in aquatic environments polluted with phthalates. (Author's abstract)
W88-06948

REPRODUCTION OF MALLARDS FED SELENIUM,
Patuxent Wildlife Research Center, Laurel, MD.
G. H. Heinz, D. J. Hoffman, A. J. Krynitsky, and D. M. G. Weller.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 6, p 423-433, June 1987. 1 fig, 8 tab, 33 ref.

Descriptors: *Hatching, *Bioaccumulation, *Selenium, *Ducks, *Population exposure, *Water pollution effects, Morbidity, Mortality, Diet, Dose-response relationships, Toxicity.

Mallards (Anas platyrhynchos) were fed diets containing 1, 5, 10, 25 or 100 ppm selenium as sodium selenite, a diet containing 10 ppm selenium as seleno-DL-methionine or a control diet, to determine whether environmentally realistic dietary levels of selenium affected the condition of or reproduction in mallards. There were no effects of 1, 5, or 10 ppm selenium as sodium selenite on either weight or survival of adults or on reproductive success, and there did not appear to be a dose-response relationship at these lower levels. The 100 ppm selenium diet killed 11 of 12 adults; one adult male fed 25 ppm selenium died. Selenium at 25 and 100 ppm caused weight loss in adults. Females fed 25 ppm selenium took longer to begin laying eggs and intervals between eggs were longer than in females in other treatment groups. Hatching success appeared to be reduced in birds fed 10 ppm selenium as selenomethionine, but the reduction was not statistically significant. The survival of ducklings and the mean number of 21-d-old ducklings produced per female were reduced in the 25 ppm selenium as sodium selenite group and the 10 ppm selenium as selenomethionine group. Egg weights were not affected by any selenium treatment, but 25 ppm selenium lowered the Ratcliffe Index. Duckling weights at hatching and at 21 d of age were reduced 28 and 36%, respectively, in birds fed 25 ppm selenium, as compared with controls. Body weights measured on day 21 were lower for ducklings fed 10 ppm selenium as selenomethionine than in some other groups. Selenium in concentrations of 10 and 25 ppm as sodium selenite caused mainly embryotoxic effects, whereas 10 ppm as selenomethionine was more teratogenic, causing hydrocephaly, bill defects, eye defects ((microphthalmia and anophthalmia) and foot and toe defects, including ectrodactyly. Selenomethionine was much more readily taken up by mallards and passed into their eggs than was sodium selenite, and a greater proportion of the selenium in the eggs ended up in the white when selenomethionine was fed. Adult males accumulated more selenium than did females, probably because of the females' ability to eliminate selenium in their eggs. (Author's abstract)
W88-06949

PREDICTIVE MODELS FOR PHOTOINDUCED ACUTE TOXICITY OF POLYCYCLIC AROMATIC HYDROCARBONS TO DAPHNIA MAGNA, STRAUSS (CLADOCERA, CRUSTACEA),
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. L. Newsted, and J. P. Giesy.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 6, p 445-461, June 1987. 5 fig, 8 tab, 49 ref. National Sea Grant College Program Grant No. NA 85AA-D-SG045.

Descriptors: *Hydrocarbons, *Model studies, *Daphnia, *Toxicity, *Population exposure, *Water pollution effects, Model studies, Photophysics, Mortality, Statistical analysis, Regression analysis, Correlation coefficient.

The photodynamic, acute toxicities of 20 polycyclic aromatic hydrocarbons (PAHs) to Daphnia magna were predicted by photophysical and physiochemical parameters. The photophysical parameters considered were lowest singlet energy, lowest triplet energy, singlet-triplet splitting energy and phosphorescence lifetime. The physiochemical parameters were first- and second-order connectivity indices and log P values. D. magna were exposed to aqueous solutions of each PAH such that equimolar concentrations in D. magna were achieved. The organisms and the PAHs were than exposed to 120 microwatts/square cm UV-A and 25 microwatts/square cm UV-B light. Mortality times (min) were recorded and the results reported as median lethal time (LT50). Potency factors were calculated and used to rank the PAHs in terms of relative photodynamic toxicity. Some statistically relevant correlations between individual physical paramters and toxicity were observed. Linear, multiple regression models were poor predictors of photoinduced PAH toxicity. A curvelinear model was developed to predict photoinduced toxicity from triplet energy. Goodness-of-fit chi-square tests were performed and demonstrated that triplet energy was an effective predictor both

of observed LT50 and of LT50 values adjusted to a constant PAH concentration. Toxicity data were also analyzed using discriminant functional analysis. A stepwise, canonical correlation parameter selection method separated the PAHs into three toxic categories by using triplet energy and phosphorescence lifetime as variables. This model, which classifies PAHs as very toxic, moderately toxic or non-toxic, was 100% accurate when the model developed from one set of PAHs was tested with a different set. (Author's abstract)
W88-06950

EFFECT OF SUSPENDED SOLIDS AND NATURALLY OCCURRING DISSOLVED ORGANICS IN REDUCING THE ACUTE TOXICITIES OF CATIONIC POLYELECTROLYTES TO AQUATIC ORGANISMS,
Petrolite Corporation, Environmental Studies Group, St. Louis, Missouri 63119.
G. A. Cary, J. A. McMahon, and W. J. Kuc.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 6, p 469-474, June 1987. 1 fig, 5 tab, 13 ref.

Descriptors: *Suspended solids, *Dissolved solids, *Toxicity, *Water pollution effects, *Minnows, *Daphnia, Cations, Water treatment, Polymers, Aquatic populations, Dose-response relationships.

Cationic polyelectrolytes comprise a large group of chemicals designed to react with and flocculate suspended solids. Their primary use is as water clarification aids in the removal of suspended solids from water supplies and from industrial and domestic effluents entering receiving waters. Many of these water-soluble macromolecules exhibit an acute toxicity to aquatic organisms of less than 1.0 mg/L. The interaction of residual amounts of these polymers in receiving waters is unclear. The effects of suspended solids (bentonite, illite, kaolin and silica) and of dissolved organic carbon compounds (humic, fulvic and tannic acids, lignin and lignosite) on the acute toxicities of four cationic water clarification aids to the fathead minnow (Pimephales promelas) and a cladoceran (Daphnia magna) were determined. Bentonite and all of the dissolved organic carbon compounds reduced the toxicities of the polymers by one to two orders of magnitude. The remaining suspended solids had a lesser effect in reducing toxicity. (Author's abstract)
W88-06951

EFFECTS OF DIMILIN(RT) ON FRESHWATER LITTER DECOMPOSITION,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
M. C. Swift, R. A. Smucker, and K. W. Cummins.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 2, p 161-166, February 1988. 4 fig, 1 tab, 22 ref. U.S. DOE Grant No. DE-FG-05-85ER60301, Maryland Dept. of Agriculture Grant No. MDA-541-FY86.

Descriptors: *Water pollution sources, *Detritus, *Pesticides, *Litter, *Chemical properties, *Water pollution effects, *Bottom sediments, *Biodegradation, Leaching, Biomass, Macroinvertebrates, Aquatic animals, Decomposition, Mortality, Bioassay.

The pesticide Dimilin(RT) (diflubenzuron) is widely used on forests in Maryland to control gypsy moths, and it may enter streams via leaf litter. The effects of Dimilin on stream leaf litter processing were measured using artificial leaf packs treated with the pesticide. Over the entire study period (464 degree days) the Dimilin-treated packs were processed more rapidly than control packs. There was a continuous loss of Dimilin from the packs, apparently due to leaching. Both Dimilin-treated and control packs were quickly colonized by macroinvertebrates and the maximum total macroinvertebrate biomass occurred when about 50% of the leaf-pack biomass remained. The macroinvertebrate community in the leaf packs was typical for western Maryland. There was little difference in the macroinvertebrate communities on the Dimilin-treated and the control packs; any possible differences between treatments were probably obscured by recolonization of the packs by invertebrate drift. Bioassays were conducted using two shredder macroinvertebrates (Tipula abdominalis and Platycentropus radiatus) to compare growth and mortality when they were fed untreated and Dimilin-treated tulip poplar leaves. Mortality was significantly higher and growth significantly lower in the shredders fed Dimilin-treated leaves. (Author's abstract)
W88-06955

TOXICOKINETICS OF CHLOROBENZENES IN FISH,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
G. Van Hoogen, and A. Opperhuizen.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 3, p 213-219, March 1988. 2 fig, 2 tab, 20 ref.

Descriptors: *Toxicity, *Pesticide toxicity, *Lethal limits, *Guppies, *Water pollution effects, *Polychlorinated biphenyls, Organic compounds, Mortality, Mathematical models, Biological magnification.

In acute toxicity tests with guppies (Poecilia reticulata), lethal effects were found for 1,2,3-tri, 1,2,3,4-tetra-, and pentachlorobenzene if the concentrations in the fish approached 2.0 to 2.5 micromol/g fish. The lethal concentrations were equal for the three test compounds and were independent of the exposure conditions. The lethal concentrations of chlorobenzene in guppies were equal to those previously found for polychlorinated biphenyls in goldfish but approximately two times higher than those found for chlorinated phenols in goldfish. Combinations of the exposure times and exposure concentrations causing mortality can be described and readily predicted with a first-order bioconcentration model. (Author's abstract)
W88-06959

DETERMINATION OF DOSE-TIME-RESPONSE RELATIONSHIPS FROM LONG-TERM ACUTE TOXICITY TEST DATA,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W88-06960

MUTAGENIC AND CLASTOGENIC PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE: A POTENT BACTERIAL MUTAGEN IN DRINKING WATER,
Toxicology and Microbiology Division, Health Effects Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio.
J. R. Meier, W. F. Blazak, and R. B. Knohl.
Environmental and Molecular Mutagenesis, Vol. 10, No. 4, p 411-424, 1987. 4 fig, 5 tab, 19 ref. Cooperative agreement CR-812579.

Descriptors: *Chlorination, *Mutagenicity, *Drinking water, *Toxicity, *Hydrogen ion concentration, *Water pollution effects, Hamsters, Morbidity, Organic compounds, Polychlorinated biphenals, Dose-response relationships, Population exposure, Microbiological studies.

3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) was found to be a direct-acting mutagen in the Ames test for strains TA1535, TA1538, TA92, TA97, TA98, TA100 and TA102. The highest mutagenic response (approx. 13,000 revertants/nmol) was seen in strain TA100. The TA100 response was six- to tenfold higher than in TA98, TA97, and TA102, and 100- to 500-fold higher than in TA1535, TA92, and TA1538. The addition of a 9,000 x g supernatant fraction (S-9) from livers of polychlorinated biphenyl-treated rats, along with cofactors for NADPH generation, resulted in a 90% reduction in the TA100 mutagenicity. MX induced chromosomal aberrations in chinese hamster ovary cells after 6-8 hr exposure without S-9 at a dose as low as 4 microgram/ml, and after 2 hr exposure with S-9 at a dose of 75 microgram/ml. The oral dose of MX lethal to 50% (LD50) in Swiss-Webster mice was determined to be 128 mg/kg. MX did not induce micronuclei in mouse bone marrow when administered by oral gavage at doses up to 70% of the LD50. (Author's abstract)
W88-06964

RELATIVE CANCER RISKS OF CHEMICAL CONTAMINANTS IN THE GREAT LAKES,
K. M. Bro, W. C. Sonzogni, and M. E. Hanson.
Environmental Management EMNGDC, Vol. 11, No. 4, p 495-505, August 1987. 3 fig, 2 fig, 31 ref. NOAA grant NA84AA-D-00065, project E/E-1, NOAA grant NA83AA-D-0069.

Descriptors: *Risk assessment, *Toxins, *Great Lakes, *Water pollution effects, *Drinking water, *Public health, *Carcinogens, Potable water, Lakes, Fish.

The drinking of water or eating of fish from the Great Lakes constitutes the consumption of potentially carcinogenic chemicals. The importance of putting into perspective the risks these contaminants pose is discussed. Based on recent measurements of carcinogens in Great Lakes fish and water, calculations of lifetime risks of cancer indicate that consumers of sport fish face cancer risks from Great Lakes contaminants that are several orders of magnitude higher than the risks posed by drinking Great Lakes water. But drinking urban groundwater and breathing urban air may be as hazardous as frequent consumption of sport fish from the Great Lakes. It Making such comparisons is difficult because of variation in types and quality of information available and in the methods for estimating risk. It is concluded that much uncertainty pervades the risk assessment process in such areas as estimating carcinogenic potency and human exposure to contaminants, and that if risk assessment is to be made more useful, it is important to quantify this uncertainty. (Author's abstract)
W88-06966

MICROCOSM STUDY OF NITROGEN UTILIZATION IN THE GREAT SALT LAKE, UTAH,
Utah State Univ., Logan.
F. J. Post, and J. C. Stube.
Hydrobiologia HYDRB8, Vol. 158, p 89-100, January 1988. 5 fig, 7 tab, 33 ref. Office of Water Research Technology (A-024-UTAH).

Descriptors: *Great Salt Lake, *Nitrogen, *Bacterial growth, *Limnology, *Nitrification, *Lake sediments, Bacterial physiology, Algae, Lakes, Nitrates, Ammonia, Urea, Glutamic acid.

Microcosms were used to study the effects of two inorganic nitrogen sources (ammonia and nitrate and two organic nitrogen sources (urea and glutamic acid) on the growth of algae and bacteria found in the Great Salt Lake, Utah. Ammonia, nitrate and urea stimulated bacterial growth indirectly through increased algal production of unknown organic substances. Glutamic acid, representing readily available organic carbon and nitrogen, stimulated the bacteria directly. No nitrification was observed in the microcosms although nitrite was found when the microcosms were supplemented with nitrate. Lake sediment contained a number of anaerobic bacteria producing hydrogen sulfide, methane and other gases. Production of these gases was stimulated in the columns with high algal and bacterial activity. (Author's abstract)
W88-06979

TEMPORAL AND GEOGRAPHICAL DISTRIBUTIONS OF EPILITHIC SODIUM DODECYL SULFATE-DEGRADING BACTERIA IN A POLLUTED SOUTH WALES RIVER,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
For primary bibliographic entry see Field 5B.
W88-07014

INFLUENCE OF PH ON MICROBIAL HYDROGEN METABOLISM IN DIVERSE SEDIMENTARY ECOSYSTEMS,
Wisconsin Univ., Madison. Dept. of Bacteriology.
S. Goodwin, R. Conrad, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 590-593, February 1988. 1 fig, 2 tab, 20 ref. DOE Grant DE-FG02-85ER13376.

Descriptors: *Eutrophication, *Lake sediments, *Acid rain effects, *Limnology, *Hydrogen ion concentration, *Kinetics, *Anaerobic conditions, *Microbial degradation, *Biodegradation, Turnover rate, Trophic level, Microorganisms, Microbiological studies, Ecosystems, Sediments, Water pollution effects.

Hydrogen transformation kinetic parameters were measured in lake sediments from anaerobic systems covering a wide range of environmental pH values to assess the influence of pH on hydrogen metabolism. The concentrations of dissolved hydrogen were measured and hydrogen transformation kinetics of the sediments were monitored in the laboratory by monitoring hydrogen consumption progress curves. The hydrogen turnover rate constants (k sub t) decreased directly as a function of decreasing sediment pH, and the maximum hydrogen uptake velocities (V sub max) varied as a function of pH within each of the trophic states. Conversely, the half-saturation concentrations (K sub m) were independent of pH. The steady-state hydrogen concentrations were at least 2 orders of magnitude lower than the half-saturation constants for hydrogen uptake. Dissolved hydrogen concentrations were at least fivefold higher in sediments from eutrophic lakes than from oligotrophic and dystrophic lakes. The rates of hydrogen production determined from the assumption of steady state decreased with sediment pH. These data indicate that progressively lower pH values inhibit microbial hydrogen-producing and -consuming processes within sedimentary ecosystems. (Author's abstract)
W88-07015

HAZARD ASSESSMENT OF CHEMICALLY DISPERSED OIL SPILLS AND SEABIRDS,
Canadian Wildlife Service, Environment Canada, Ottawa, Ontario, K1A 0E7, Canada.
D. B. Peakall, P. G. Wells, and D. Mackay.
Marine Environmental Research MERSDW, Vol. 22, No. 2, p 91-106, 1987. 2 fig, 3 tab, 35 ref.

Descriptors: *Water pollution effects, *Population exposure, *Seabirds, *Dispersants, *Oil spills, *Oil pollution, *Hazardous materials, Toxicity, Food habits, Animal physiology, Ecological effects, Birds.

The effects of dispersants on both the exposure to and toxicity of oil to seabirds were considered in order to assess the hazard. Ideally the dispersant mixes with oil and disperses it into the water column. This process is rapid but generally incomplete. The toxicology of one dispersant (Corexit 9527), for which data are available, shows that the toxicity of oil-Corexit mixtures is similar to that of oil alone. The effect of two feeding regimes, pursuit diving and surface diving, was considered. Calculations indicate that the amount of oil that is likely to be taken up by the bird while moving through the water column is small. It is concluded that there is little evidence of synergistic effects between oil and dispersant. The major oiling of birds occurs at the surface and thus dispersants must be highly effective to reduce the exposure of birds to oil. (Author's abstract)
W88-07027

HEMOCYTES OF MYTILUS EDULIS AFFECTED BY PRUDHOE BAY CRUDE OIL EMULSION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. G. McCormick-Ray.
Marine Environmental Research MERSDW, Vol. 22, No. 2, p 107-122, 1987. 5 fig, 3 tab, 46 ref.

Descriptors: *Water pollution effects, *Population exposure, *Oil pollution, *Mytilus, *Hemocytes, *Tissue analysis, Toxicity, Animal physiology, Bioindicators, Stress.

Hemocytes and tissues of Mytilus edulis were examined after 4-5 or 8-9 weeks exposure to 390 micrograms/L or 740 micrograms/L Prudhoe Bay crude oil emulsion, during the animals' most metabolically active season. A reduction in hemocytes occurred in animals exposed to 740 micrograms/L after 4-5 weeks. After 8-9 weeks, hemocyte counts of both test groups increased, due to higher densities of granulocytes, yet the phagocytic response was reduced. Agranulocyte densities were reduced in animals exposed to 390 micrograms/L, due to lower counts of 2-3 micron agranulocytes. Adipogranular cell percentages in test animals were reduced. The initial reduction in granulocytes, their increases with time, and the reduced densities of agranulocytes in mussles exposed to emulsion may be indicators of a general adaptive response to stress. (Alexander-PTT)
W88-07028

MODELING THE INHIBITORY EFFECTS OF METALS ON PHYTOPLANKTON GROWTH,
Dept. of Plant Science, Univ. of Alberta, Edmonton, Alberta, Canada.
J. S. Goudey.
Aquatic Toxicology AQTODG, Vol. 10, No. 5/6, p 265-278, August 1987. 5 fig, 1 tab, 40 ref.

Descriptors: *Water pollution effects, *Population exposure, *Phytoplankton, *Model studies, *Heavy metals, *Reproduction, Simulation, Prediction, Mathematical studies, Toxicity, Plant physiology, Growth.

A mass transport model was developed to describe the growth responses of phytoplankton populations exposed to a metal. Growth of the population (change in cell numbers over time) was related to interactions among processes regulating the available metal concentration in solution, uptake, and the dilution of cell metal through growth. Model simulations were consistent with previous observations of the variable growth responses exhibited by phytoplankton populations exposed to metals including the presence of the extended lag phase and a gradual reduction in cell numbers over time. The model was also used to interpret published data from diverse sources on variations in final yields (cell numbers) and cell metal contents observed in experiments terminated after a fixed exposure period. Predictions of phytoplankton growth under non-steady conditions (fluctuating available metal concentration, variable growth rate, variable uptake rate) provide additional insight on how interactions among physicochemical and biological processes can affect the toxic properties of metals in a variable environment. (Author's abstract)
W88-07029

EFFECTS OF DIFLUBENZURON ON LIMB REGENERATION AND MOLTING IN THE FIDDLER CRAB, UCA PUGILATOR,
Dept. of Biological Sciences, Rutgers Univ., Newark, NJ, U.S.A.
J. S. Weis, R. Cohen, and J. K. Kwiatkowsi.
Aquatic Toxicology AQTODG, Vol. 10, No. 5/6, p 279-290, August 1987. 2 fig, 4 tab, 33 ref.

Descriptors: *Water pollution effects, *Population exposure, *Animal physiology, *Diflubenzuron, *Crabs, Organic compounds, Mortality, Survival, Pesticides, Sediments.

Fiddler crabs, Uca pugilator, were exposed to the insect growth regulator diflubenzuron (Dimilin (R)) at 0.5, 5, and 50 micrograms/L after multiple autotomy of one chela and five walking legs. Regeneration of the first walking leg was monitored, and time to ecdysis, mortality, and morphology of the regenerated limbs observed. Continuous exposure to the chemical produced a dose-dependent mortality at ecdysis. Exposure to the pesticide for a single week produced similar but less severe effects. However, if crabs molted while in the pesticide, significant mortality was observed. The presence of sediment in the container with the crab moderated the effects of the pesticide, but did not eliminate them. The regenerated limbs of the crabs that survived ecdysis had lesions in the form of black areas in which the cuticle was improperly developed. These lesions were seen in crabs that had been in the pesticide for only one week (week 2 or week 3) as well as those that had continuous exposure. They were also seen in crabs that regenerated in Dimilin with sediment. In addition, the number of setae on limbs was reduced compared to the number on limbs that had regenerated in clean sea water. (Author's abstract)
W88-07030

STRUCTURE-FUNCTION RELATIONSHIPS FOR MONITORING CELLULAR STRESS AND RECOVERY RESPONSES WITH SELENASTRUM CAPRICORNUTUM,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5A.
W88-07031

ACUTE TOXICITY OF THREE DETERGENTS AND TWO INSECTICIDES IN THE LUGWORM, ARENICOLA MARINA (L.): A HISTOLOGICAL AND A SCANNING ELECTRON MICROSCOPIC STUDY,
Station Biologique, Roscoff, France.
E. Conti.
Aquatic Toxicology AQTODG, Vol. 10, No. 5/6, p 325-334, August 1987. 6 fig, 2 tab, 21 ref.

Descriptors: *Water pollution effects, *Toxicity, *Detergents, *Insecticides, *Lugworms, Tissue analysis, Population exposure, Morphology.

The toxicity of three detergents (sodium dodecyl benzene sulfonate, sodium dodecyl sulfate and Triton X-100) and two insecticides (Carbaryl and Parathion-ethyl) on the lugworm, Arenicola marina, was investigated. The 48-h LV50 values were established and the morphological alterations in epidermis, gills and intestine were analyzed by light and scanning electron microscopy. The three detergents were equally toxic (LC50 from 12 to 15 mg/L) while the insecticides were more potent (LC50 = 7.2 and 2.7 mg/L, for the Carbaryl and the Parathion-ethyl, respectively). The gills and the epidermis receptors were the most sensitive sites of the lugworm, while the thoracic epidermis was the most resistant of the structures studied. (Author's abstract)
W88-07032

ACUTE TOXICITY OF INORGANIC SELENIUM TO DAPHNIA MAGNA (STRAUS) AND THE EFFECT OF SUB-ACUTE EXPOSURE UPON GROWTH AND REPRODUCTION,
Queen Mary Coll., London (England). School of Biological Sciences.
P. A. Johnston.
Aquatic Toxicology AQTODG, Vol. 10, No. 5/6, p 335-352, August 1987. 9 fig, 4 tab, 25 ref.

Descriptors: *Selenium, *Water pollution effects, *Toxicity, *Heavy metals, *Daphnia, *Sublethal effects, Reproduction, Growth rates, Mercury, Water pollution control, Population exposure.

The acute toxicities of sodium selenite (Na_2SeO_3) and sodium selenate (Na_2SeO_4) to Daphnia magna were determined in defined culture at 22 deg C. For adults, the 48-h LC50 values were 0.68 ppm selenium as selenite and 0.75 ppm selenium as selenate. Juveniles were more sensitive, with a 48-h LC50 of 0.55 ppm selenium as selenate. Eggs and embryos were found to be much less sensitive, with a 72-h LC50 of 1.4 ppm selenium as selenate. Sub-acute exposure of D. magna to sodium selenate cause suppression of growth over instars 1-5 and reduced egg production in instar 9 when adults were exposed to test solutions from instar 6 onwards. These sublethal effects were found at concentrations in the range proposed as suitable for the use of selenium in the amelioration of mercury contamination. (Author's abstract)
W88-07033

OCCURRENCE AND SIGNIFICANCE OF CRYPTOSPORIDIUM IN WATER,
Arizona Univ., Tucson. Dept. of Microbiology.
J. B. Rose.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 53-58, February 1988. 1 fig, 5 tab, 50 ref.

Descriptors: *Water treatment, *Water pollution effects, *Epidemiology, *Drinking water, *Public health, *Water conveyance, *Cryptosporidium, Human diseases, Filtration, Wastewater, Population exposure.

Three outbreaks of waterborne disease have been attributed to Cryptosporidium - two linked to drinking water and a third to surface water - yet the risk of waterborne disease is unknown because many factors may contribute to transmission. Of 107 surface water samples collected in six western states, 77 were positive for the presence of Cryptosporidium oocysts. A high count was found in raw sewage (1,732 oocysts.L), whereas low counts were found in waters without waste discharges (0.04 oocysts/L). Cryptosporidium has also been detected in drinking water. Little information is available, on oocyst survival in the environment or during sewage and drinking water treatment processes. Further research is necessary to define the variables that will influence the possible presence of infectious oocysts in water. It has been suggested that the epidemiology and transmission of Cryptosporidium are similar to Giardia. Based on environmental occurrence, the risk of Cryptosporidium transmission by the water route may be equal to or greater than that of Giardia. (Author's abstract)
W88-07037

SOME EFFECTS OF METAL SALTS AND ACID PRECIPITATION ON THE FRESHWATER TRICLAD POLYCELIS FELINA (DALYELL),
Dept. of Life Sciences, Trent Polytechnic, Nottingham, U.K.
B. Pyatt, and P. Crossland.
Environmental Education and Information, Vol. 6, No. 1, p 91-94, January-March 1987. 1 ref.

Descriptors: *Water pollution effects, *Population exposure, *Monitoring, *Acid rain, *Bioindicators, *Toxicity, *Triclads, *Heavy metals, Hydrogen ion concentration, Salts, Acidity, Artificial participation, Stream pollution.

Investigations using freshwater triclads (Turbellaria) to monitor pollutants are described. Aluminum and copper ions, in freshwater solution, were toxic within 48 hr to freshwater triclads collected in Nottinghamshire; lead was less toxic. Nitrate was generally more toxic to Polycelis felina than chloride. Water of a pH in excess of 5.0 was not toxic to the triclads, collected from a stream with a pH of 8.2, within the experimental period. Water acidified to simulate acid rain at pH 4.0 was extremely toxic. (Author's abstract)
W88-07050

AGE AND GROWTH, REPRODUCTIVE CYCLE, AND HISTOCHEMICAL TESTS FOR HEAVY METALS IN HARD CLAMS, MERCENARIA MERCENARIA, FROM RARITAN BAY, 1974-75,
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
J. Ropes.
Fishery Bulletin FSYBAY, Vol. 85, No. 3, p 653-662, July 1987. 3 fig, 3 tab, 38 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Bioaccumulation, *Bioindicators, *Population exposure, *Heavy metals, *Reproduction, *Clams, *Raritan Bay, Tissue analysis, Phytoplankton, Food chains, Salinity.

A study was undertaken to assess potential impacts of contaminants in Raritan Bay on the spawning potential of hard clams. Monthly samples were collected from three study areas within the bay to obtain measurements of the shells, soft body tissues for observations of general condition, and gonadal tissues for observations of the reproductive cycle. Selected specimens were chosen to determine age and growth, and special tissue samples were collected for histochemical tests of certain metals. Shell dimensions and shell and body weights clearly indicated a smaller size for hard clams at Ward Point than at New Drop Beach and Horseshoe Cove, which was reflected in the age estimates. Reported age and growth determinations for hard clams suggest that the Ward Point portion of the Raritan Bay population was being adversely affected. The absence of large, old hard clams in the present samples may be the result of pollution effects. A lower diversity of phytoplankton in the vicinity of Ward Point may have resulted in lower amounts of food organisms being available for the nutritional needs of the clams, and was probably reflected in their slower growth and poor meat condition. Gonadal development culminated in spawning at three Raritan Bay sample sites. This suggests that the reproductive capacity of hard clams in Raritan Bay was not being affected by pollutants. The negative results of histochemical tests for heavy metals in Raritan Bay hard clams are not readily explained. Hydrographic conditions (not specifically sampled for during the present study) probably influenced the growth and survival of hard clams in Raritan Bay. Throughout Raritan Bay no growth of adult clams would be expected during winter due to low bottom temperatures (2.3 deg - 3.0 deg C); slow growth would occur during the increasing and decreasing temperatures of the spring and fall. Near normal growth probably occurs at New Dorp Beach and Ward Point during the summer when temperature means appeared to be near optimum conditions. Salinities near the New Dorp Beach area were all within the tolerance limits for adult hard clams. (Author's abstract)
W88-07064

USEFULNESS OF COMPREHENSIVE FEASIBILITY STUDIES IN ENVIRONMENTAL EPIDEMIOLOGY INVESTIGATIONS: A CASE STUDY IN MINNESOTA,
Section of Chronic Disease and Environmental Epidemiology, Minnesota Dept. of Health.
A. P. Bender, A. N. Williams, J. M. Sprafka, J. S. Mandel, and C. P. Straub.
American Journal of Public Health AJHEAA, Vol. 78, No. 3, p 287-290, March 1988. 18 ref.

Descriptors: *Water pollution effects, *Management planning, *Path of pollutants, *Population exposure, *Epidemiology, *Feasibility studies, Water pollution sources, Public health, Economic aspects, Case studies, Cancer, Water supply, Wells, Minnesota.

Episodes of public water supply contamination with industrial or agricultural chemicals frequently give rise to public concerns about adverse health effects. These concerns may precipitate epidemiologic or clinical investigations requiring large expenditures of state and federal resources regardless of whether such investigations are justified by scientific criteria. An alternative is a comprehensive feasibility study, utilizing all available information to determine whether large-scale studies are warranted or feasible. At a relatively modest cost, a feasibility study allows health officials to identify information needs and deficiencies, outline potential study options and costs, clearly establish the rationale for a proposed study or, conversely, prevent unwarranted expenditures of public resources. Furthermore, a feasibility study may in itself resolve many community and scientific concerns. This article provides a case study of the usefulness of a formal feasibility study in a situation involving an elevated cancer rate and contaminated municipal water supply wells surrounding a federal superfund site. (Author's abstract)
W88-07066

EPIDEMIC GIARDIASIS CAUSED BY A CONTAMINATED PUBLIC WATER SUPPLY,
Div. of Field Services, Epidemiology Program Office, Centers for Disease Control, Atlanta, GA 30333.
G. P. Kent, J. R. Greenspan, J. L. Herndon, L. M. Mofenson, and J.-A. S. Harris.
American Journal of Public Health AJHEAA, Vol. 78, No. 2, p 139-143, February 1988. 2 fig, 2 tab, 15 ref.

Descriptors: *Water pollution effects, *Population exposure, *Epidemiology, *Drinking water, *Giardiasis, *Public water supply, *Public health, *Pittsfield, Massachusetts, Chlorination, Reservoirs, Pollutant identification, Surface water, Diarrhea.

In the period November 1, 1985 to January 31, 1986, 703 cases of giardiasis were reported in Pittsfield, Massachusetts (population 50,265). The community obtained its water from two main reservoirs (A and B) and an auxiliary reservoir (C). Potable water was chlorinated but not filtered. The incidence of illness peaked approximately two weeks after the city began obtaining a major portion of its water from reservoir C, which had not been used for three years. The attack rate of giardiasis for residents of areas supplied by reservoir C was 14.3/1000, compared with 7.0/1000 in areas that received no water from reservoir C. A case-control study showed that persons with giardiasis were more likely to be older and to have drunk more municipal water than household controls. A community telephone survey indicated that over 3,800 people could have had diarrhea that might have been caused by Giardia, and 95 per cent of households were either using alternate sources of drinking water or boiling municipal water. Environmental studies identified Giardia cysts in the water of reservoir C. Cysts were also detected in the two other reservoirs supplying the city, but at lower concentrations. This investigation highlights the risk of giardiasis associated with unfiltered surface water systems. (Author's abstract)
W88-07069

LEGIONNAIRES' DISEASE ACQUIRED WITHIN THE HOMES OF TWO PATIENTS, LINK TO THE HOME WATER SUPPLY,
Infectious Disease and Special Pathogens Section, Veterans Administration Medical Center.
J. E. Stout, V. L. Yu, and P. Muraca.
Journal of the American Medical Association JAMAA, Vol. 257, No. 9, p 1215-1217, March 1987. 24 ref.

Descriptors: *Water supply, *Legionnaire's disease, *Pathogens, *Water pollution effects, *Population exposure, *Epidemiology, *Public health, *Legionella, *Domestic water supply, Pollutant identification, Immunology.

Two patients with sporadic community-acquired legionnaires' disease are described. Legionella pneumophila was isolated from sputum specimens, and seroconversion of antibody titers was demonstrated for both patients. Legionella pneumophila was also recovered from the residential water supply of both patients. In each case, the serogroup of the environmental organism matched that of the infecting organism. In one patient, serogroup 3 was isolated - a rare cause of legionnaires' disease, and in the second case, monoclonal antibody testing confirmed that the serogroup 1 organisms isolated from sputum and residential water supply samples were identical. The incubation period of legionnaires' disease is presumed to be up to two weeks. Because of medical problems, both patients had been confined to their homes for the entire two weeks before the onset of symptoms. This is the first report that links acquisition of community-acquired legionnaires' disease to contaminated water supplies within the homes of susceptible patients. (Author's abstract)
W88-07070

COMMON-SOURCE COMMUNITY AND INDUSTRIAL EXPOSURE TO TRICHLOROETHYLENE,
Div. of Environmental and Occupational Medicine, Mt. Sinai School of Medicine, 1 Gustave L. Levy Place, New York, NY.
For primary bibliographic entry see Field 5B.
W88-07071

ACUTE TOXICITY OF AMMONIA AND NITRITE TO SPOTTED SEATROUT,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
H. V. Daniels, C. E. Boyd, and R. V. Minton.
Progressive Fish Culturist PFCUAY, Vol. 49, No. 4, p 260-263, October 1987. 1 tab, 12 ref.

Descriptors: *Fish farming, *Aquaculture, *Toxicity, *Ammonia, *Nitrites, *Sea trout, *Water pollution effects, Fish, Lethal limit, Fish eggs, Larvae, Ions, Mortality.

Median lethal concentrations (LC50) of ammonia and nitrite were determined for spotted seatrout (Cynoscion nebulosus) in static tests. Ammonia toxicity tests were conducted with eggs, larvae hatched from eggs previously exposed to ammonia (ammonia-exposed eggs), larvae hatched from eggs not previously exposed to ammonia (unexposed eggs), 1-month-old juveniles, and 4-month-old juveniles. Nitrite toxicity tests were conducted with eggs and larvae. Spotted seatrout eggs were the life history stage most tolerant of un-ionized ammonia; 91.6% hatch occurred at 6.0 mg NH3-N/liter. The 24-hour LC50 for larvae hatched from both ammonia-exposed and unexposed eggs was 0.28 mg NH3-N/liter. The 24-hour LC50 of nitrite for larvae was 980 mg NO2-N/liter; 92% hatch occurred at 1,200 mg NO2-N/liter. Tolerance of un-ionized ammonia increased with age through the 4-month juvenile stage; the respective 24-hour NH3-N LC50s for 1- and 4-month old juveniles were 1.38 and 1.98 mg/liter, and the respective 96-hour LC50s were 0.98 and 1.72 mg/liter. (Author's abstract)
W88-07076

REPRODUCTIVE RESPONSES OF FIVE WHITE SUCKER (CATOSTOMUS COMMERSOND) POPULATIONS IN RELATION TO LAKE ACIDITY,
Toronto Univ. (Ontario). Dept. of Zoology.
E. A. Trippel, and H. H. Harvey.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1018-1023, May 1987. 5 tab, 39 ref.

Descriptors: *Acid rain effects, *Limnology, *Acidic water, *Water pollution effects, *Fish reproduction, *Fish populations, *Lakes, Sucker, Hydrogen ion concentration, Fish physiology, Populations, Mortality, Ontario, Life history studies, Acid rain, Reproduction.

White sucker (Catostomus commersoni) in three acid lakes (pH 4.90, 5.56, and 5.58) frequently matured at older ages and larger sizes and had shorter reproductive life spans than white sucker in two circumneutral lakes (pH 6.30 and 6.35). Reproductive life span was positively correlated in females ($r = 0.97$) and males ($r = 0.85$) with lake pH. In the acid lakes, elevated mortality rates coincided with the onset of sexual maturity whereas in circumneutral lakes, mortality rates did not change at maturity. Ovarian weight and ovarian somatic index values were not significantly different between females from two acid and two circumneutral lakes. Values of fecundity, ova dry weight, testicular weight, and testicular somatic index of fish in acid lakes were either significantly greater than or equal to values in white sucker from circumneutral lakes. Results are discussed within the context of life history theory. (Author's abstract)
W88-07087

MICROBIAL COMMUNITIES ON LEAF MATERIAL PROTECTED FROM MACROINVERTEBRATE GRAZING IN ACIDIC AND CIRCUMNEUTRAL STREAMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
A. V. Palumbo, P. J. Mulholland, and J. W. Elwood.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1064-1070, May 1987. 3 fig, 2 tab, 33 ref. Electric Power Research Institute Contract RP2326-1. USDOE Contract DE-AC05-840R21400.

Descriptors: *Acid rain effects, *Bacteria, *Grazing, *Decomposition, *Macroinvertebrates, *Microbiological studies, *Water pollution effects, *Acid streams, *Acidic water, Streams, Hydrogen ion concentration, Aluminum, Microbial degradation, Leaves, Respiration.

To determine how low pH and high aluminum concentrations directly affect microbial activity on decomposing leaves in streams, the microbial communities on leaf surfaces were examined using in situ flow-through chambers which exclude macroinvertebrates. Bacterial production (thymidine incorporation) on leaf material was significantly higher at pH 6.4 than at 4.9 after 4 weeks of incubation, and this difference persisted for the last 5 weeks of the experiment. Microbial respiration was greater at the high pH site after 6 weeks, and there were no significant differences in ATP standing stock. Concentrations of oxalate-extractable aluminum on the leaf material increased significantly within the first 4 weeks of incubation and stabilized at significantly greater levels at low pH (4.66 milligrams/gram) than at high pH (1.70 milligrams/gram). Transferring leaf material from the high-pH to the low pH stream had negative effects after only 1 week of incubation. However, transferring from low pH to high pH did not result in significant positive effects until 4 weeks after the transfers. The reduced microbial production and respiration in the low-pH stream imply that decomposition rates may be slower in acidified systems due, at least in part, to direct effects of acidification on microbial activity. (Author's abstract)
W88-07089

PREEXPOSURE AND SUBSEQUENT RESISTANCE TO LEAD IN YEARLING BROOK TROUT, SALVELINUS FONTINALIS,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
Y. Tang, and E. T. Garside.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 5, p 1089-1091, May 1987. 1 tab, 17 ref.

Descriptors: *Heavy metals, *Toxicity, *Lead, *Water pollution effects, *Trout, *Fish physiology, *Acclimatization, Fish, Sublethal effects, Lethal limit, Mortality.

Potential for acclimation of brook trout, Salvelinus fontinalis, at sublethal levels of dissolved lead was measured. Samples of yearlings (19.2 plus or minus 6.1 grams) were preexposed continuously to environmentally realistic sublethal levels (10, 24, and 37 micrograms (ug) Pb/liter) for 10, 20, 30, and 40 days and subsequently exposed to a lethal level (2 milligrams Pb/liter) during which the incidence of mortality was recorded. Survival intervals of fish preexposed to 10 ug Pb/liter were not significantly different from those preexposed to tap water (<2 ug Pb/liter) in each preexposure interval. Fish preexposed to 24 ug Pb/liter for 10 and 20 days were less resistant but returned to normal resistance after 30 and 40 days of preexposure. Fish preexposed to 37 ug Pb/liter had significantly shorter survival intervals than those preexposed to tap water in each preexposure interval. The maximum acceptable toxicant concentration (MATC) of lead for brook trout is set between 24 and 37 ug Pb/liter. (Author's abstract)
W88-07091

LIFE STAGE AND POPULATION VARIATION IN RESISTANCE AND TOLERANCE OF HYALELLA AZTECA (AMPHIPODA) TO LOW PH,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
R. L. France, and P. M. Stokes.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 6, p 1102-1111, June 1987. 8 fig, 4 tab, 41 ref.

Descriptors: *Acid rain effects, *Acidic water, *Amphipods, *Water pollution effects, *Lethal limit, Hydrogen ion concentration, Crustaceans, Genetics, Mortality, Snowmelt, Lakes, Ontario, Resistance, Tolerance, Aquatic populations, Population exposure, Canada.

Lethality experiments revealed that resistance of Hyalella azteca (Amphipoda) to low pH was directly related to size and developmental stage. Exposure of adults to water below pH 5.0 during pulses of acid snowmelt, or of juveniles to below pH 5.5 through gradual lake acidification, could result in population decline. Hyalella azteca from moderately acidic Ontario lakes (pH 5.6-5.7) survived longer at lethal pH than did amphipods from circumneutral lakes (pH 6.4-7.2) where spring pH depressions do not occur. Resistance and tolerance to low pH was neither readily lost by tolerant amphipods exposed to neutral water for 10 days nor readily gained by nontolerant amphipods exposed to a sublethal low pH for a similar duration. This absence of physiological plasticity of individual H. azteca suggests that population differences in acid tolerance may result from processes of selective mortality with or without a genetic basis. (Author's abstract)
W88-07093

EMPIRICAL HYPOTHESIS TO EXPLAIN THE RESTRICTED DISTRIBUTION OF HYALELLA AZTECA (AMPHIPODA) IN ANTHROPOGENICALLY ACIDIFIED LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
R. L. France, and B. D. LaZerte.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 6, p 1112-1121, June 1987. 5 fig, 2 tab, 39 ref.

Descriptors: *Acid rain effects, *Limnology, *Acidic water, *Amphipods, *Water pollution effects, *Model studies, *Acid lakes, *Distribution patterns, Populations, Ontario, Lakes, Hydrogen ion concentration, Plastic lake, Mortality, Littoral zone, Crustaceans, Simulation, Seasonal variation, Acid rain, Mathematical models, Prediction, Snowmelt, Population exposure.

A simple and speculative model is proposed to explain the restricted distribution of Hyalella azteca (Amphipoda) within acidified Ontario lakes. The model integrates field chemical and ecological data with results from laboratory toxicological experiments. Frequent spring depression of pH to below 5.0, measured in the littoral zone of Plastic Lake during 1982, were predicted to cause a mortality of 35.2% to a theoretically constructed amphipod population. A time trend simulation suggests that population decline of H. azteca in similar anthropogenically acidified lakes could be caused by such direct mortality due to short-term pH fluctuations. Assumptions and factors not considered by the model which could exacerbate or mitigate the effects of acidic snowmelt to H. azteca are discussed. Because of the simple model design, the assumptions made in the simulation are the same as those implicit in laboratory toxicology work when attempts are made to extrapolate the experimental results to natural situations. Factors which were not included in the model, but which could exacerbate the decline of H. azteca populations exposed to lake acidification included: (1) interaction with the metals characteristically found in pulses of acidic snowmelt; (2) memory of previous acid stress; and (3) effects of long-term life cycle changes in reproduction. Factors not under consideration in the model which could mitigate the effects of acidic snowmelt included: (1) amphipod avoidance of acidic water; (2) acclimatization or natural selection; (3) population compensatory mechanisms; and (4) macrophyte buffering. (Wood-PTT)
W88-07094

INFLUENCE OF COMPLEXATION AND PH ON INDIVIDUAL AND COMBINED HEAVY METAL TOXICITY TO A FRESHWATER GREEN ALGAE,
Department of Fisheries and Oceans, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Canada Centre for Inland Waters, Burlington, Ont. L7R 4A6.
M. E. Starodub, P. T. S. Wong, C. I. Mayfield, and Y. K. Chau.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 6, p 1173-1180, June 1987. 7 tab, 35 ref.

Descriptors: *Chelation, *Acid rain effects, *Heavy metals, *Toxicity, *Heavy metals, *Water pollution effects, *Chlorophyta, *Algae, *Metal complexes, Hydrogen ion concentration, Copper, Zinc, Lead, Toxicity, Algal growth, Scenedesmu, Synergistic effects, Algal growth.

The effect of complexation and pH on heavy metal (Cu, Zn, Pb) toxicity to a freshwater green alga, Scenedesmus quadricauda, was investigated. Extracellular ligands produced by S. quadricauda were capable of binding heavy metals and reducing their single and combined toxicities. Apparent complexing capabilities and the ability of the sediment humics and artificial complexing agents such as ethylenediaminetetraacetic acid (EDTA), citric acid, and glycolic acid to ameliorate Cu, Zn, or Pb toxicity were also assessed. The toxicity of metals to algal growth was enhanced at acidic pH. Combined toxicity of these metals was significantly greater at pH 4.5 than at pH 8.5 or pH 6.5. Synergistic effects (between Cu, Zn, and Pb) towards algal growth increased at low pH. Specific heavy metals, their respective concentrations, the presence of complexing ligands, and pH influence both individual and combined heavy metal toxicities. (Author's abstract)
W88-07096

CHANGES IN THE ABUNDANCE OF BLUE-GREEN ALGAE RELATED TO NUTRIENT LOADINGS IN THE NEARSHORE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. Y. B. Chang, and R. Rossman.
Hydrobiologia HYDRB8, Vol. 157, No. 3, p 271-278, January 22, 1988. 5 fig, 25 ref.

Descriptors: *Water pollution effects, *Lakes, *Limnology, *Nutrients, *Cyanophyta, *Algae, Lake Michigan, Phytoplankton, Stratification, Thermal stratification, Phosphorus, Silica, Seasonal variation, Diatoms.

Phytoplankton samples were collected from 1970 to 1981 and phosphorus loadings were determined from 1974 to 1981 in the area of the St. Joseph River mouth in Lake Michigan. The reduced phosphorus loads led to major changes in the phytoplankton community, with increases in the abundance and occurrence of blue-green algae, especially after thermal stratification began. The small decline in phosphorus concentrations each year expanded the period of phosphorus limitation, enhancing the relative abundance of those species which can utilize lower concentrations of available phosphorus. Phosphorus-stimulated dissolved silica limitation of diatom growth was apparent during the summer thermal stratification. (Cassar-PTT)
W88-07099

BIOGEOCHEMICAL CYCLING OF SELENIUM IN THE SAN JOAQUIN VALLEY, CALIFORNIA, USA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W88-07103

SOME PROBLEMS ASSOCIATED WITH BREWERY AND DAIRY WATER DISCHARGES,
Science College, Mosul University, Mosul, Iraq.
M. N. Khayat, T. A. Mahmoud, and S. A. Abbawi.
Environment International ENVIDV, Vol. 12, No. 5, p 563-569, 1986. 1 fig, 8 tab, 5 ref.

Descriptors: *Water pollution sources, *Wastewater pollution, Ponds, *Watewater analysis, *Industrial wastes, *Dairy industry, *Brewery industry, *Iraq, Water quality, Tigris River, Fish kills, Dissolved oxygen, Standards, Water supply.

Dairy and brewery industries are considered to be major pollution sources of Tigris River in Mosul city in Iraq. A daily flow of 3000 cu m3 of raw waste of these industries which carries a considerable level of solids, organic load, and other pollutants is discharged without any treatment into Tigris River through two ponds. During flood season, the washout of the wastewater of these ponds causes a sudden local drop in the dissolved oxygen level of the river water; consequently, the river suffers a great damage demonstrated normally by mass fish kill. The waste also has an adverse effect on the agricultural productivity of the adjacent land. In this study, a quantitative an qualitative evaluation was made to determine the characteristics of the wastewater discharged throughout the year by these two industries. The change in the waste strength due to mixing and ponding prior to its final disposal to the river was studied. Additionally, an attempt was made to define the change in the river water quality due to the industrial discharge. The authors concluded that, according to WHO standards, the Tigris is suitable as a drinking water source but will sooner or later reach a stage where increasing volumes of untreated domestic and industrial waste can no longer be tolerated. (Author's abstract)
W88-07124

FSC OIL POLLUTION RESEARCH UNIT--THE 1980S AND BEYOND,
Oil Pollution Research Unit, Orielton Field Centre, Pembroke, Dyfed SA71 5EZ.
For primary bibliographic entry see Field 5G.
W88-07128

PHYSICAL MODEL STUDY OF THERMAL AND CHEMICAL POLLUTION IN THE SHUAIBA OFFSHORE AREA OF KUWAIT,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
J. M. Lo, and I. I. Esen.
Environment International ENVIDV, Vol. 13, No. 3, p 253-259, 1987. 4 fig, 2 tab, 4 ref.

Descriptors: *Thermal pollution, *Process waters, *Hydraulic models, *Cooling water, *Chemical pollution, *Kuwait, *Water temperature, *Heated water, *Model studies, *Seawater, Effluents, Industrial wastewater, Recirculated water, Temperature gradient, Arabian Gulf.

The cooling and process waters of the industrial plants located in the Shuaiba Industrial Area in Kuwait are supplied by a complex system of seawater cutlets and intakes. Discharge of heated water from the industrial plants is considered a major problem since it may recirculate directly through the intake towers, and the cooling water withdrawn may be at a higher temperature than is desirable. Higher cooling water temperature reduces the efficiency of industrial plants and causes thermal pollution, which adversely affects the water of the Arabian Gulf. In addition, the discharged process water may cause chemical pollution in the offshore area. An undistorted physical model with a scale of 1:50 was constructed and tested with the basic objectives of determining the temperature field in the Shuaiba offshore area, identifying possible recirculation patterns and temperature increase at the intakes, examining the flow and mixing characteristics of chemical effluents discharged, and investigating alternative remedial measures. The model test results showed that, in line with the field tests, the temperature of the sea water at the intakes was about 1.7-2.5C higher than the ambient temperature. When heated water from the larger outlets was allowed to discharge into a channel running parallel to the shoreline and curved to stay parallel to the outside of the southern breakwater of the Shuaiba harbor, the temperature increase at the intakes was limited to 0.8-1.0 C and tests showed the concentration of conservative chemical pollutants at the intakes was reduced by about 50%. (Author's abstract)
W88-07130

PRELIMINARY CHARACTERIZATION OF A NOVEL SYNECHOCOCCUS ISOLATE SHOWING MERCURY, CADMIUM AND LEAD TOLERANCE,
Department of Microbiology, Bhopal University, Bhopal 462 026, India.
P. S. Bisen, H. D. Shukla, A. Gupta, and S. N. Bagchi.
Environmental Technology Letters ETLEDB, Vol. 8, No. 9, p 427-432, September 1987. 2 fig, 1 tab, 17 ref.

Descriptors: *Cyanobacteria, *Tolerance, *Toxicity, *Bacteria, *Industrial wastewater, *Heavy metals, *Mercury, *India, *Cadmium, *Lead, Microbiological studies, Trace metals, Wastewater, Cultures, Synechococcus, Adaptation.

Mercury, cadmium and lead are common heavy metal pollutants of industrial wastes. A Synechococcus isolate from an industrial effluent exhibited significantly higher Hg++, Cd++, Pb++ tolerance when compared with a wild type Synechococcus cedrorum strain. The upper tolerance levels of the isolate with Hg++, Cd++, Pb++ were 10, 60 and 60 ug ml, respectively. (Author's abstract)
W88-07145

ROLE OF QUALITY ASSURANCE IN NATIONAL ACID RAIN RESEARCH IN THE UNITED STATES,
Northrop Services, Inc., Research Triangle Park, NC.
For primary bibliographic entry see Field 7C.
W88-07149

EFFECTS OF SALINITY AND WATERLOGGING ON THE VEGETATION OF LAKE TOOLIBIN, WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 4C.
W88-07168

HUMAN GLUTATHIONE PEROXIDASE ACTIVITY IN CASES OF HIGH SELENIUM EXPOSURES,
California Univ., Los Angeles. School of Public Health.
J. L. Valentine, B. Faraji, and H. K. Kang.
Environmental Research ENVRAL, Vol. 45, No. 1, p 16-27, February 1988. 5 fig, 3 tab, 44 ref. EPA Research Grant R-803798-01.

Descriptors: *Selenium, *Drinking water, *Enzymes, *Water pollution effects, *Population exposure, Blood, Urine, Chemical analysis, Bioassay, Wyoming, Nevada.

Glutathione peroxidase activity has been shown to reflect selenium status in deficient and adequate states; however, during instances of excess supplementation a point was reached where the enzyme's activity in blood showed a decrease with continued selenium administration. Two populations in Wyoming which received naturally occurring excess selenium in their drinking water, Jade Hills and Red Butte near the city of Casper, were selected for study; levels of selenium in the water for these respective communities were 194 and 494 micrograms/liter. Participants from the city of Casper receiving low-selenium water, 1.7 micrograms/liter, were selected as controls; in addition data on participants from the city of Sun Valley, Nevada, with drinking water containing < 3.1 micrograms/liter selenium, are reported for comparison to Casper participants. Samples of blood, urine, and tap water were obtained from participants in each community and analyzed for selenium content. Blood samples were also analyzed for glutathione peroxidase activity. Results showed an increase in selenium concentration in the urine as the water selenium increased. Selenium concentrations in blood did not reflect the increased selenium exposure. Glutathione peroxidase activity in whole blood decreased in highly exposed participants compared to those with low exposure. It is concluded that glutathione peroxidase activity in cases of possible environmental toxic exposures will not show the increased activity seen in supplementation of selenium to deficient subjects. (Author's abstract)
W88-07169

ACID NEUTRALIZING CAPACITY OF LEAVES EXPOSED TO ACIDIC FOG,
California Univ., Riverside. Statewide Air Pollu-

tion Research Center.
For primary bibliographic entry see Field 5B.
W88-07175

GROWTH PARAMETER AND YIELD COMPONENT RESPONSE OF FIELD CORN TO SIMULATED ACID RAIN,
Illinois Univ., Urbana. Dept. of Agronomy.
W. L. Banwart, P. M. Porter, E. L. Ziegler, and J. J. Hassett.
Environmental and Experimental Botany EEBODM, Vol. 28, No. 1, p 43-51, January 1988. 6 tab, 12 ref. EPA Cooperative Agreement 810725-01.

Descriptors: *Air pollution effects, *Plant growth, *Crop yield, *Corn, *Acid rain, *Simulated rainfall, Corn Belt, Hydrogen ion concentration, Dry matter, Seeds, Proteins.

Acid rain occurs in the midwest including major portions of the Corn Belt. Studies have suggested minimal yield response of field corn (Zea mays) to acid rain. However, small but significant reductions in yield have been shown for some cultivars under extreme conditions. To define these yield changes further effect of simulated acid rain on parameters associated with corn yield was studied. Cultivars B73xMo17 and Pioneer 3377 were shielded from ambient rain by two movable rain exclusion shelters. Six simulated rain treatments (pH 5.6, 4.6, 4.2, 3.8, 3.4, 3.0) were applied biweekly within these shelters through a nozzle distribution system. Growth and yield parameters were unaffected by simulated rain treatment. Analysis of 2 years of data for 100-seed dry weight, dry matter production, cob weight, barren plants, and seed protein content indicated no significant trends with treatment pH for either cultivar. However, when contrasted with all other treatments, a small yield reduction observed at pH 3.0 for B73xMo17 (6%) was associated with a similar reduction in ears (5%), cob dry weight (5%), kernels per ear (3%), and slightly increased (3%) seed protein. Thus, while the only significant yield reduction was a contrast of pH 3.0 and the average of all other treatments for B73xMo17, this reduction appears to be the result both of slightly fewer ears and slightly less successful ear fill. (Author's abstract)
W88-07176

AQUATIC MACROPHYTES OF LAKE MIZE, FLORIDA, 1968-1980,
Clayton State College, Morrow, GA 30260.
For primary bibliographic entry see Field 2H.
W88-07181

ASBESTOS IN DRINKING WATER AND CANCER,
Department of Medical Statistics, Charing Cross and Westminster Medical School, London, England.
For primary bibliographic entry see Field 5B.
W88-07211

UNSUITABILITY OF WORLD HEALTH ORGANISATION GUIDELINES FOR FLUORIDE CONCENTRATIONS IN DRINKING WATER IN SENEGAL,
Department of Human Nutrition, Agricultural University, Wageningen, The Netherlands.
For primary bibliographic entry see Field 3C.
W88-07213

BLADDER CANCER, DRINKING WATER SOURCE, AND TAP WATER CONSUMPTION: A CASE-CONTROL STUDY,
National Cancer Inst., Bethesda, MD. Div. of Cancer Etiology.
K. P. Cantor, R. Hoover, P. Hartge, T. J. Mason, and D. T. Silverman.
Journal of the National Cancer Institute JNCIAM, Vol. 79, No. 6, p 1269-1279, December 1987. 7 tab, 61 ref.

Descriptors: *Human diseases, *Public health, *Epidemiology, *Risks, *Potable water, *Drinking water *Water pollution sources, *Water pollution effects, *Chlorination, Disinfection, Chemical properties, Toxicity, Surface water, Groundwater, Cancer.

Data from a population-based case-control interview study of incident bladder cancer in 10 areas of the United States were used to estimate relative risks among white men (2,116 cases, 3,892 controls) and women (689 cases, 1,366 controls) according to beverage intake level and type of water source. Individual year-by-year profiles of water source and treatment were developed by linking lifetime residential information with historical water utility data from an ancillary survey. Risk of bladder cancer increased with intake level of beverages made with tap water. The odds ratio (OR) for the highest vs. lowest quintile of tap water consumption was 1.43. The risk gradient with intake was restricted to persons with at least a 40-year exposure to chlorinated surface water and was not found among long-term users of nonchlorinated ground water. The ORs for the highest vs. lowest quintiles of tap water intake were 1.7 and 2.0, respectively, among subjects with 40-59 and > or = 60 yr exposure. Duration of exposure to chlorinated surface water was associated with bladder cancer risk among women and nonsmokers of both sexes. Among nonsmoking respondents with tap water consumption above the population median, the OR increased with exposure duration to a level of 3.1 for > or = 60 years of residence at places served by chlorinated surface water (vs. nonchlorinated ground water users). These results extend findings of earlier epidemiologic studies and are consistent with environmental chemistry and toxicologic data demonstrating the presence of genotoxic by-products of chlorine disinfection in treated surface waters. (Author's abstract)
W88-07215

EVALUATION OF COSTS ASSOCIATED WITH REGIONAL, ENVIRONMENTAL IMPACT IN CHESAPEAKE BAY,
West Virginia University, Morgantown, WV.
For primary bibliographic entry see Field 6B.
W88-07224

TREATMENT ALTERNATIVES FOR NITRATE CONTAMINATED GROUNDWATER SUPPLIES,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-07225

ACID PRECIPITATION AND ITS EFFECTS ON WATER QUALITY OF SMALL RIVER BASINS IN RHODE ISLAND,
Rhode Island Univ., Kingston. Water Resources Center.
C. P. C. Poon, and T. Chaplin.
Journal of Environmental Systems, Vol. 17, No. 2, p 79-92, 1987. 3 fig, 2 tab, 13 ref.

Descriptors: *Acid rain, *Air pollution effects, *Path of pollutants, *Water quality, *Small watersheds, Rhode Island, Aquatic environment, Transparency, Leaching, Human pathology, Acidity, Alkalinity, Hydrogen ion concentration, Satellite technology, Radar, Maps, Storms, Deposition, River flow, Land use, Flood peak.

The effects of acid precipitation on the water acidity, alkalinity, and pH of three small rivers in Rhode Island rural areas were studied. Satellite pictures, radar scans, and pressure maps were used to trace storm paths. In general, more acidity was found in storms coming from the west-southwest direction. Rainfall pH as low as 3.81 and another rainfall with strong acid components at a concentration of 0.000159 N were recorded. The degree of impact on river water quality depended on storm acidity, storm size, amount of dry deposition prior to the storm, river flow prior to the storm, and land use pattern in the watershed. A drop of half a pH unit in a river could take place in half a day. The largest pH drop recorded was 2.15 units and the largest increase of acidity was elevenfold. The impact on water quality could last longer than five days from the onset of the maximum impact, which generally coincided with that of the peak flow, to the time of recovery of the pre-storm water acidity, alkalinity, and pH. (Author's abstract)
W88-07226

ACIDIFICATION AND ANADROMOUS FISH OF ATLANTIC ESTUARIES,
Brookhaven National Lab., Upton, NY. Terrestrial and Aquatic Ecology Div.
G. B. Hendrey.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 1-6, September 1987. 12 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Acid rain, *Water pollution, *Acid streams, *Fish, *Anadromous fish, *Fish populations, *Estuaries, *Conferences, Population dynamics, Salmon, Shad, Alewife, Herring, Striped bass, Perch, Hydrogen ion concentration, Chemistry of precipitation, Organic compounds, Eutrophication, North America, Atlantic Ocean, Chesapeake Bay.

The Hudson River Foundation convened a conference to evaluate evidence pertaining to the roles played by acid deposition and stream acidification in the decline of anadromous fish populations along the Atlantic coastal plain. The stimuli for the conference were that (1) some populations of Atlantic salmon, American shad, hickory shad, alewives, blueback herring, and striped bass as well as a few species resident in coastal streams (yellow perch and white perch) are in a state of severe decline along portions of the east coast of North America; (2) several of these species have declined more-or-less simultaneously since about 1970; and (3) severe episodic pH depressions are observed in some streams of the Chesapeake Bay system. For example, the pH of Lyons Creek decreased from 7.0 to 5.9 in 1 hr during a rain event, returning to 7.0 a day later. After discussing several possible mechanisms for these observations, the conferees agreed that a combination of factors including stream and river acidification, toxic metals and organic compounds, eutrophication and overfishing appears to be contributing to the reduction in fish stocks. The essential point resulting from the conference is that the acid deposition hypotheses for stream acidification and declines of anadromous fish populations, a potential mechanism that has received very little attention heretofore, was shown to be viable for these coastal areas. Specific recommendations for research were agreed upon by the conferees. (Author's abstract)
W88-07255

SUMMARY OF THE IMPACT OF ACID RAIN ON ATLANTIC SALMON (SALMO SALAR) IN CANADA,
Fisheries Research Branch, Halifax, Nova Scotia B3J 2S7, Canada.
W. D. Watt.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 27-35, September 1987. 5 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Acid rain, *Acidity, *Aquatic habitat, *Rivers, *Anadromous fish, *Salmon, North America, Canada, Nova Scotia, Chemical properties, Sulfuric acid, Hydrogen ion concentration, Sulfates, Aluminum, Organic compounds, Anions, Limestone, Mathematical models, Regression analysis, Cost-benefit analysis.

Within the present North American range of Atlantic salmon, severe acid rain effects are limited to the Southern Upland area of Nova Scotia. In the Southern Upland, long-range transport of sulfuric acid has caused many rivers to decline in pH to the point where their Atlantic salmon stocks have been destroyed or much diminished. Chemical records show a declining pH trend in Nova Scotia rivers since the early 1950s. Eighty percent of the annual variation in hydrogen ion concentration can be accounted for by a multiple linear regression model on excess sulfate, total aluminum, and organic anions. It is technically feasible to restore the acidified salmon habitat by the addition of limestone; the total cost of mounting a liming program

to restore the lost habitat has been estimated at $4,750,000/yr. The pre-acidification Atlantic salmon production capacity of the Southern Upland was estimated from physical habitat surveys and tag return data to be about 45,000 fish/yr. Acidification has caused a 50% decline to the current production level of about 23,000 fish/yr. The costs of the liming program, when compared to the economic benefit of the anticipated salmon enhancement, are economically unjustifiable. The eradication of salmon from such large regions will hinder future programs to reestablish the species in their former range when pollution of the atmosphere is eventually brought under control. Present plans are for a small liming program to establish a series of refuges for the preservation of nuclei of native salmon stocks. (Author's abstract)
W88-07258

ATLANTIC SALMON RESOURCES IN THE NORTHEASTERN UNITED STATES AND THE POTENTIAL EFFECTS OF ACIDIFICATION FROM ATMOSPHERIC DEPOSITION,
Maine Univ., Orono. Dept. of Zoology.
T. A. Haines.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 37-48, September 1987. 5 fig, 3 tab, 34 ref.

Descriptors: *Water pollution effects, *Acid rain, *Acidity, *Aquatic habitat, *Rivers, *Anadromous fish, *Salmon, *Fish populations, North America, United States, Maine, Connecticut River, Delaware River, Environmental effects, Dam effects, Water pollution sources, Acid streams, Toxicity, Fish establishment, Fish stocking, Chemical properties, Hydrogen ion concentration, Aluminum.

The Atlantic salmon (Salmo salar) was formerly abundant in northeast coastal rivers in the United States from the Canadian border to the Connecticut River, and possibly as far south as the Delaware River. It was eliminated from most of its former range by a combination of overfishing, construction of dams impassable to migrating fish, and municipal and industrial pollution. Reproducing populations are now limited to a few rivers in Maine, but attempts are under way to reintroduce the species to some rivers where populations formerly existed. Most of the native Atlantic salmon rivers are low in acid neutralizing capacity and receive acidic precipitation. The third-order streams are not now acidic; however, in some first- and second-order streams in Maine, pH episodically declines to 4.7 and aluminum increases to 350 micrograms/gr. These conditions could be toxic to sensitive early life-history stages of Atlantic salmon. Comparison of chemical conditions in two Maine rivers in 1980-1982 with those in 1969-1970 indicated that the streams have not become more acidic during this interval. Data on the sport catch of Atlantic salmon indicated that populations have generally remained stable or recently increased in the Maine rivers having naturally reproducing populations. The recent increase probably resulted from introductions of hatchery smolts to supplement natural reproduction, and the occurrence of strong year classes in 1978 and 1980. The population in one stream has declined significantly in recent years, but the cause of the decline is probably not related to acidic precipitation. Atlantic salmon resources in the U.S. have apparently not been adversely affected by atmospheric deposition at the present time. (Author's abstract)
W88-07259

STATUS OF SOME FINFISH STOCKS IN THE CHESAPEAKE BAY,
Maryland Dept. of Natural Resources, Annapolis. Fisheries Administration.
H. J. Speir.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 49-62, September 1987. 9 fig, 33 ref.

Descriptors: *Fish, *Anadromous fish, *Fish populations, *Estuaries, United States, *Chesapeake Bay, *Water pollution effects, Striped bass, Shad, Herring, Perch, Fish harvest, Commercial fishing, Sport fishing, Acid rain, Environmental quality.

The Chesapeake Bay is one of the largest and most productive estuaries in the United States. The fish and shellfish harvest in 1979 totaled 284,500,000 kg. Although historical measures of stock size are less than optimum, commercial landings and indices of reproductive success indicate declines in several species of anadromous and semi-anadromous finfish. Causes for the declines may be due to point and non-point sources of water pollution, acid deposition, or overfishing. The Environmental Protection Agency Chesapeake Bay Study identified a number of major environmental problems in the Bay but the exact linkages between environmental problems and fish stocks have not been made. (Author's abstract)
W88-07260

CHEMICAL AND BIOLOGICAL TRENDS ASSOCIATED WITH ACIDIC ATMOSPHERIC DEPOSITION IN THE RHODE RIVER WATERSHED AND ESTUARY,
Smithsonian Environmental Research Center, Edgewater, MD.
D. L. Correll, J. J. Miklas, A. H. Hines, and J. J. Schafer.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 63-86, September 1987. 14 fig, 3 tab, 42 ref. NSF Grants DEB-7911563, DEB-8207212, BSR-831648, and CEE-8219615.

Descriptors: *Rhode River, *Acid rain, *Watersheds, *Estuaries, *Water pollution sources, *Chesapeake Bay, *Water pollution effects, Aquatic environment, Estuarine environment, Ions, Hydrogen ion concentration, Acidity, Aluminum, Agricultural watersheds, Forest watersheds, Streams, Groundwater pollution, Aquatic animals, Frogs, Fish, Perch, Striped bass, Spawning.

The Rhode River estuarine/watershed system is a tributary of Chesapeake Bay. Bulk precipitation pH in the spring season declined from 4.95 in 1974 to 3.82 in 1981 and was 4.03 in 1985. The changes in pH of a forested primary stream were more related to changes in bulk precipitation pH than were the changes in pH of agricultural streams, reflecting the importance of other major terrestrial sources of acidity on agricultural systems. Surges in acidity and dissolved total aluminum concentration in primary (first-order) streams reached extremes of pH 3.2 and 300 micrograms Al/l. Higher-order streams had surges in acidity with pH minima < 5.0. Surges in acidity occurred during accelerated groundwater percolation following storm events and did not coincide with surface runoff or snowmelt. One reason why groundwater is more acidic than surface runoff is that the vegetation exchanges hydrogen ions for alkaline cations in the soil and translocates these ions to the vegetational canopy. When it rains, hydrogen ions in the precipitation displace some of these cations, while groundwater is enriched in hydrogen ions. Although the source of dissolved aluminum is dissolution of clay minerals with atomic ratios of aluminum to silicate of 1:1, 1:2, or 1:3, this ratio in stream water rapidly declined to 1:1200 due to loss of aluminum. On average, forest drainage was the most acidic, the highest in dissolved aluminum and the lowest in calcium. Surges in acidity were most severe from pastureland, and next most severe from cropland. Larval bioassays of acidity indicate negligible toxicity to spring peepers, significant toxicity to yellow perch, and drastic effects on striped bass at pH 5.0. (Author's abstract)
W88-07261

ACIDIFICATION EFFECTS ON LARVAL STRIPED BASS, MORONE SAXATILIS IN CHESAPEAKE BAY TRIBUTARIES: A REVIEW,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 87-96, September 1987. 4 tab, 46 ref. FWS Cooperative Agreements 14-16-0009-84-909 and 14-16-0009-85-910.

Descriptors: *Acid rain, *Water pollution effects, *Acidity, *Fish, *Anadromous fish, *Striped bass, *Chesapeake Bay, Estuaries, Tributaries, Susquehanna River, Potomac River, Rappahannock River, Water quality, Pollutants, Spawning, Larvae, Mortality, Toxicity, Chemical properties, Hydrogen ion concentration, Aluminum, Hardness.

Reduced striped bass populations along the East Coast of the United States have prompted numerous studies to assess various factors contributing to the decline. Available data from on-site and laboratory studies with striped bass in conjunction with water quality and contaminants data confirm that the eastern shore rivers of the Chesapeake Bay (Choptank, Nanticoke, and Pocomoke Rivers) are susceptible to acidic conditions. The Choptank and Nanticoke Rivers are significant striped bass spawning areas. Acidification conditions (low pH, aluminum, low hardness) were documented in these systems in 1984 at levels reported to cause high mortality to striped bass larvae. Striped bass populations in several western shore tributaries such as the Mattaponi, Pamunkey, Patuxent, and Rappahannock Rivers also appear to be vulnerable to acidic pH conditions. In-situ toxicity studies documenting actual striped bass larval mortality are lacking in these systems; however, based on laboratory data it appears that potentially toxic acidic conditions can exist. Although certain Chesapeake Bay spawning tributaries do exhibit acidic conditions during spawning periods, other systems are resistant to acidification. The Chesapeake and Delaware Canal, Elk River, and Susquehanna River of the Upper Chesapeake Bay and the Potomac River on the western shore appear to be resistant to reductions in pH. The upper Chesapeake Bay and Potomac River are major striped bass spawning areas. Therefore, reduced striped bass production in these systems may be related to factors other than acidification. (Author's abstract)
W88-07262

INFLUENCE OF PH ON THE TOXICITY OF ALUMINIUM AND OTHER INORGANIC CONTAMINANTS TO EAST COAST STRIPED BASS,
Columbia National Fisheries Research Lab., MO.
D. R. Buckler, P. M. Mehrle, L. Cleveland, and F. J. Dwyer.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 97-106, September 1987. 5 tab, 20 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Water quality, *Hydrogen ion concentration, *Acidity, *Toxicity, *Mortality, *Aluminum, *Fish, *Anadromous fish, *Striped bass, Chemical properties, Pollutants, Inorganic compounds, Estuaries, Chesapeake Bay, Acid rain, Fish populations, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, Salinity.

The abundance of anadromous stocks of striped bass in the Chesapeake Bay region has declined since 1970. Various hypotheses bearing on possible causes of the decline have been proposed and tested. The effect of water quality variables, pH in particular, on the toxicity of known environmental contaminants to early life stages of striped bass was examined. The results of studies in which two life stages of striped bass were exposed to a series of aluminum concentrations at various pH levels in reconstituted soft fresh water indicated that the toxicity of aluminum was pH-dependent and that the toxicity of acidity was age-dependent. The toxicity of aluminum plus a mixture of inorganic contaminants (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) to young striped bass in reconstituted soft fresh and reconstituted saline water was also demonstrated to be age- and pH-dependent. Toxicity of the contaminants was increased with decreases of pH of the test waters. Toxicity from low pH was more severe upon younger fish. At 5 parts per thousand salinity, no mortality attributable to the inorganic contaminant mixture plus aluminum occurred at concentrations up to twice those in fresh water. The interaction between low pH from acid deposition and inorganic contaminants should be considered as a possible factor contributing to the decline in abundance of east coast striped bass. (Shidler-PTT)
W88-07263

CHRONIC TOXICITY OF AN ENVIRONMENTAL CONTAMINANT MIXTURE TO YOUNG (OR LARVAL) STRIPED BASS,

National Fisheries Contaminant Research Center, Columbia, MO.
P. M. Mehrle, L. Cleveland, and D. R. Buckler.

Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 107-118, September 1987. 3 fig, 4 tab, 15 ref.

Descriptors: *Water pollution effects, *Water quality, *Toxicity, *Mortality, *Salinity, *Fish, *Anadromous fish, *Striped bass, *Larvae, Aquatic environment, Chemical properties, Pollutants, Estuaries, Chesapeake Bay, Potomac River, James River, Fish populations, Well water, Organic compounds, Hydrocarbons, Polychloronated Biphenyls, Organic pesticides, Inorganic compounds, Spawning.

Larvae of striped bass, Morone saxatilis, were exposed to a mixture of organic and inorganic contaminants in fresh well water and 2/g l saline water for 30 days and 5 g/l saline water for 90 days. Environmental concentrations of organic and inorganic chemicals were estimated for the Chesapeake Bay area. Striped bass were exposed to the environmental concentration; 0.25, 0.5, 2, and 4 times the environmental concentration; and a solvent control to simulate potential conditions in their spawning and nursery habitats in Chesapeake Bay. The contaminant mixture was formulated to represent mixtures of organic polynuclear aromatic hydrocarbons, PCBs, organochlorine pesticides, and inorganic chemicals found in water samples from the Elk, Potomac, James, and Choptank Rivers in the Chesapeake Bay area. The sensitivities of striped bass as determined by survival depended on the characteristics of the exposure water. Larvae exposed in fresh well water were the most susceptible to the contaminant mixture; the 2 and 4 times environmental concentration treatments caused significant mortality within 30 days. In the 2 g/l salinity water, the 4 times environmental concentration treatment caused significant mortality after 30 days of exposure. Larvae exposed to the contaminant mixture for 90 days in the 5 g/l saline water incurred significant mortality in the 2 and 4 times environmental contamination treatments. It is concluded that concentration of contaminants and salinity of the environment must both be considered in evaluating the influence of environmental contaminants on the decline of striped bass along the east coast. (Author's abstract)
W88-07264

EFFECTS OF COMBINATIONS OF HEAVY METALS ON HILL ACTIVITY OF AZOLLA PINNATA,

Burdwan Univ. (India). Dept. of Botany.
A. Sarkar, and S. Jana.

Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 141-145, September 1987. 3 tab, 8 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Photosynthesis, *Photolysis, *Aquatic plants, *Floating plants, Mercury, Arsenic, Lead, Copper, Cadmium, Chromium, Water pollution, Pollutants, Plant physiology, Plant tissues, Inhibition, Antagonistic effects, Synergistic effects.

The effects of combinations of mercury, arsenic, lead, copper, cadmium, and chromium on Hill activity (photolysis of water, an important component of photosynthesis) were studied in Azolla pinnata. All combinations of heavy metals decreased Hill activity of chloroplasts over control values. The effects were most pronounced with treatments of Hg+As+Pb+Cu+Cd+Cr and Hg+As+Pb+Cu+Cd. Due to antagonistic effects, the degree of inhibition of Hill activity in A. pinnata by 2 or 3 metals in combination was less than the sum of the effects of the same metals applied individually. When 4 or more metals were applied in combination, the effect was greater than the sum of the effects of the individual metals, because of synergism. In general, the harmful effects of the individual metals were found to be in the following order of decreasing severity: Cd > Hg > Cu > As > Pb > Cr. (Author's abstract)
W88-07266

STREAM TEMPERATURE INCREASES AND LAND USE IN A FORESTED OREGON WATERSHED,

Oregon State Univ., Corvallis. Dept. of Forest Engineering.
For primary bibliographic entry see Field 2E.
W88-07273

IMPACT OF NONCHLORINATED SECONDARY AND TERTIARY EFFLUENTS ON WARM WATER FISH COMMUNITIES,

Environmental and Chemical Sciences, Inc., P.O. Box 1393, Aiken, South Carolina 29802.
M. H. Paller, R. C. Heidinger, and W. M. Lewis.

Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 65-76, February 1988. 1 fig, 6 tab, 15 ref.

Descriptors: *Secondary wastewater treatment, *Chlorination, *Toxicity, *Fish populations, *Population exposure, *Lethal limit, *Tertiary wastewater treatment, *Water pollution effects, Wastewater treatment, Water chemistry, Sand filters, Nitrification, Fish.

The fish communities in three sewage receiving Illinois streams were monitored by electrofishing as treatment changed from secondary with chlorination to secondary without chlorination to tertiary without chlorination over a 40-month period. Degradation of the fish communities was severe during the secondary treatment/chlorination period. When treatment was changed to secondary without chlorination, strong improvements occurred in the fish communities of all streams, and degradation could no longer be demonstrated on the basis of species number. The onset of tertiary treatment resulted in few additional changes in the fish communities, with the possible exception of increased abundance of several species of minnows. Tertiary treatment consisted of nitrifications, sand filtration, and, in two streams, phosphorus removal. (Author's abstract)
W88-07279

ENVIRONMENTAL IMPACT ASSESSMENT OF THE DISCHARGE OF THE EFFLUENT FROM THE FARO WASTE STABILIZATION PONDS INTO THE RIA FORMOSA, ALGARVE, PORTUGAL,

PROCESL, Engenharia Hidraulica e Ambiental, Lda., 67 Rua Castilho, 4th 1200 Lisboa, Portugal.
M. A. S. Pereira, and L. Machado.

Water Science and Technology WSTED4, Vol. 19, No. 12, p 337-339, 1987.

Descriptors: *Water pollution effects, *Path of pollutants, *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Environmental impact, Stabilization lagoons, Ria Formosa, Portugal, Salinity, Nutrients, Pathogens, Wetlands, Bacteria, Marshes, Wastewater pollution, Shellfish.

The effects of effluent discharge from a proposed stabilization pond treatment system into the Ria Formosa, Portugal, were studied. This nature reserve area is a shallow coastal water body of high ecological, economic, and touristic value. It receives little freshwater contribution except in October through April. Presently, the inner zones of the Ria, which are not flushed during the tidal changes, are odorous and have high bacterial counts from crude domestic sewage disposal. Potential impacts of effluent discharge on the Ria Formosa are (1) decrease of salinity near the discharge, (2) increase of nutrients near the discharge, and (3) microbial contamination, especially of shellfish. (Cassar-PTT)
W88-07363

SHORELINE IMPACT FROM OCEAN WASTE DISCHARGES,

California Inst. of Tech., Pasadena. W.M. Keck Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 5E.
W88-07429

EVALUATION OF THE EQUILIBRIUM CALCULATIONS WITHIN ACIDIFICATION MODELS: THE EFFECT OF UNCERTAINTY IN MEASURED CHEMICAL COMPONENTS,

Syracuse Univ., NY. Dept. of Civil Engineering.
W. D. Schecher, and C. T. Driscoll.

Water Resources Research WRERAO, Vol. 24, No. 4, p 533-540, April 1988. 4 fig, 2 tab, 31 ref.

Descriptors: *Acid rain, *Model studies, *Water pollution effects, *Water chemistry, *Aluminum, *Sulfates, Hydrogen ion concentration, Calibrations, Rainfall, Adirondacks.

There is much concern over the effects of acidic deposition on soils and drainage waters. To understand better the processes regulating the acidification of surface waters, computer models have been developed which utilize equilibrium calculations to predict the concentration of chemical parameters such as pH, acid neutralizing capacity, dissolved inorganic carbon, Al and SO4(2-). A chemical equilibrium model (ALCHEMI) was used to evaluate the effect of uncertainty in the measurement of chemical constituents on thermodynamic calculations. The water chemistry data used for this analysis were collected as part of the Regional Integrated Lake-Watershed Acidification Study, which included 17 lake-watershed systems from the New York Adirondack region. For calculations where pH was not allowed to vary (fixed pH calculations), uncertainty in Al speciation was small (maximum of 7%) and largely due to imprecision in the measurement of total F and pH. When calculations were made from electroneutrality based on measured constituents (variable pH calculations), most of the uncertainty associated with the values of output parameters was due to imprecision in the determination of SO4(2-). (Author's abstract)
W88-07443

ZOOPLANKTON-MEDIATED TRANSITIONS BETWEEN N- AND P-LIMITED ALGAL GROWTH,

Notre Dame Univ., IN. Dept. of Biological Sciences.
J. J. Elser, M. M. Elser, N. A. MacKay, and S. R. Carpenter.

Limnology and Oceanography LIOCAH, Vol. 33, No. 1, p 1-14, January 1988. 9 fig, 2 tab, 45 ref. NSF Grants BSR 83-08918 and BSR 86-06271.

Descriptors: *Limnology, *Cycling nutrients, *Zooplankton, *Algal growth, *Limiting nutrients, *Water pollution effects, Nitrogen, Phosphorus, Plant physiology, Biomass, Nutrients, Lakes.

Limitation of algal growth by nitrogen and phosphorus was assessed in three north-temperate lakes with physiological bioassays and nutrient enrichment experiments. In addition, mesocosm experiments were performed in the three lakes to examine the effects of nutrient enrichment and zooplankton biomass and size on algal nutrient status. In situ indicators of N and P availability were inversely related in magnitude and transitions between N and P limitation were abrupt. Physiological bioassay results did not indicate simultaneous limitation by N and P. However, limited responses to single-nutrient enrichment and pronounced responses to simultaneous Na and P addition in enrichment experiments suggested that potential limitation by the secondary nutrient was usually in close proximity to limitation by the primary nutrient. Transitions between N and P limitation closely accompanied major shifts in the zooplankton community. The importance of the zooplankton community in regulating the relative degree of N or P limitation was confirmed by the mesocosm experiments, which demonstrated that transitions between algal N or P limitation could be induced by manipulations of zooplankton biomass or size. This result supports a hierarchical view of the function of planktonic systems, in which biotic interactions structure the response of the algal community to a given nutrient load. (Author's abstract)
W88-07463

EVIDENCE FOR A MATERNAL YOLK FACTOR ASSOCIATED WITH INCREASED TOLERANCE AND RESISTANCE OF FERAL

WHITE SUCKER (CATOSTOMUS COMMERSONI) TO WATERBORNE COPPER,
Waterloo Univ. (Ontario). Dept. of Biology.
K. R. Munkittrick, and D. G. Dixon.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 1, p 7-20, February 1988. 4 fig, 5 tab, 34 ref.

Descriptors: *Water pollution effects, *Population exposure, *Reproduction, *Heavy metals, *Fish physiology, *Sucker, *Copper, *Zinc, *Maternal yolk factor, Survival, Tolerance, Larvae.

White suckers, collected from lakes containing elevated levels of copper (12 micrograms/L) and zinc (250 micrograms/L), were evaluated for reproductive performance, growth and survival of the larvae, and tolerance of the larvae to waterborne copper. Fertilization success was not impaired in white suckers from contaminated sites; metal-exposed males performed better than control males in fertilization trials with control eggs. Larvae hatched from eggs collected at contaminated sites and fertilized in clean water were smaller, developed at a slightly increased rate, and exhibited poorer growth and survival than larvae from control sites. Larvae showed significant changes in resistance and tolerance to copper with age. During the period of endogenous nutrition, larvae from eggs taken at contaminated sites showed increased resistance and tolerance to waterborne copper relative to controls. The effect was not seen in larvae at first feeding, at ages older than 4 days after the onset of feeding (25 days posthatch) or in larvae hatched from control eggs fertilized with sperm from males taken at contaminated sites. This study provides evidence for a maternal yolk factor associated with increased tolerance and resistance of larvae to copper. (Author's abstract)
W88-07470

SUBLETHAL EFFECTS OF TETRACHLORO-1,2-BENZOQUINONE - A COMPONENT IN BLEACHERY EFFLUENTS FROM PULP MILLS - ON VERTEBRAL QUALITY AND PHYSIOLOGICAL PARAMETERS IN FOURHORN SCULPIN,
National Swedish Environmental Protection Board, The Lab. for Aquatic Toxicology, Studsvik, S-611 82 Nykoping, Sweden.
B. E. Bengtsson, A. Larsson, A. Bengtsson, and L. Renberg.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 1, p 62-71, February 1988. 4 tab, 29 ref.

Descriptors: *Water pollution effects, *Population exposure, *Organic compounds, *Fish physiology, *Pulp wastes, *Quinones, *Sculpin, Enzymes, Amino acids, Fish.

The effects of tetrachloro-1,2-benzoquinone (TCQ), a component in bleached kraft mill effluents (BKME), on vertebral and physiological parameters were investigated in juvenile fourhorn sculpin, Myoxocephalus quadricornis L. After about 4.5 months of exposure to 0.1 and 0.5 mg TCQ/liter in 7 o/oo salinity brackish water, the fish demonstrated vertebral deformities, aberrant mechanical properties of the vertebrae, effects on white and red blood cell counts, enhanced activity of delta-aminolevulinic acid dehydratase in erythrocytes, and increased levels of ascorbic acid in the liver. All of the effects are qualitively similar to those observed in fish exposed in the laboratory to complex BKME and in feral fish in the receiving body of water from kraft pulp mills. The complex BKME cause a more multifarious response pattern and some typical effects of BKME on fish did not appear after long-term TCQ exposure. (See also W88-07475) (Alexander-PTT)
W88-07472

GROWTH OF DAPHNIA MAGNA EXPOSED TO MIXTURES OF CHEMICALS WITH DIVERSE MODES OF ACTION,
Dept. of Veterinary Pharmacology, Pharmacy and Toxicology, Univ. of Utrecht, P.O. Box 80176, 3508 TD Utrecht, The Netherlands.
J. W. Deneer, W. Seinen, and J. L. M. Hermens.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 1, p 72-77, February 1988. 2 fig, 2 tab, 21 ref.

Descriptors: *Water pollution effects, *Population exposure, *Organic compounds, *Toxicity, *Daphnia, *Growth, Additivity.

Concentrations causing inhibition of growth of Daphnia magna after 16 days of exposure were determined for nine chemicals that presumably act through different modes of action. The joint toxic effect of a mixture of these chemicals was nonadditive. When lethality was used, the joint toxicity closely corresponded to concentration addition. The additivity was substantially lowered when EC50 repro was used as the parameter. The use of the somewhat more sensitive EC10gr led to an even smaller degree of additivity. The results seem to support the belief that, when dealing with compounds acting through different mechanisms, an increase of the sensitivity of the parameter studied will lead to a decrease of the additivity in the joint action of the mixture. (Alexander-PTT)
W88-07473

TOXICITY OF CHLORPYRIFOS, ENDRIN, OR FENVALERATE TO FATHEAD MINNOWS FOLLOWING EPISODIC OR CONTINUOUS EXPOSURE,
U.S. Environmental Protection Agency, Environmental Research Lab.-Duluth, 6201 Congdon Boulevard, Duluth, Minnesota 55804.
A. W. Jarvinen, D. K. Tanner, and E. R. Kline.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 1, p 78-95, February 1988. 6 fig, 6 tab, 48 ref.

Descriptors: *Water pollution effects, *Population exposure, *Toxicity, *Organic compounds, *Minnows, *Pesticides, Fish physiology, Water quality.

Fathead minnow larvae (Pimephales promelas) were exposed to three individual pesticides during brief or continuous exposure in 96-hr and 28- to 30-day toxicity tests. Continuous exposure 96-hr LC50 values for chlorpyrifos, endrin, and fenvalerate were 122.2, 0.7, and 0.85 micrograms/L, respectively. Continuous exposure chronic effect concentrations were chlorpyrifos, 2.1 micrograms/L (increased deformities); endrin, 0.38 micrograms/L (reduction in growth); and fenvalerate, 0.36 micrograms/L (reduction in survival and growth). Brief exposure chronic test results indicated that fathead minnow exposure to chlorpyrifos for as few as 5 hr at a concentration similar to a continuous exposure 96-hr LC50 value resulted in increased deformities and a reduction in growth, whereas a 48-hr exposure at a concentration similar to a continuous exposure 96-hr LC50 value was required to cause a reduction in growth for endrin and a reduction in survival and growth for fenvalerate. It is suggested that although constant exposure laboratory tests are essential for hazard assessment, the relationships of exposure duration and toxicant intensity to ecotoxic effects are necessary for reliable risk assessments and implementation of water quality standards. (Author's abstract)
W88-07474

LONG-TERM EFFECTS OF BLEACHED KRAFT MILL EFFLUENTS ON RED AND WHITE BLOOD CELL STATUS, ION BALANCE, AND VERTEBRAL STRUCTURE IN FISH,
Dept. of Zoophysiology, Uppsala Univ., Box 560, S-751 22 Uppsala, Sweden.
J. Hardig, T. Andersson, B. E. Bengtsson, L. Forlin, and A. Larsson.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 1, p 96-106, February 1988. 1 fig, 7 tab, 27 ref.

Descriptors: *Water pollution effects, *Population exposure, *Organic compounds, *Fish physiology, *Pulp wastes, *Sculpin, Bioindicators.

In a laboratory investigation fourhorn sculpin (Myoxocephalus quadricornis) were exposed for 5-9 months to wastewater from pine and birch lines from a bleached kraft pulp plant. This long-term exposure to bleached kraft mill effluent (BKME) affected the hematology, the ion balance, and the vertebral structure. Decreased values for hematocrit and hemoglobin and a reduced red blood cell count, as well as increased levels of methemoglobin, indicated disturbances in the red blood cell status. The white blood cell picture was not significantly affected by the BKME exposure. Decreased levels of potassium and chloride ions in the blood plasma in some of the exposed fish suggest an impaired ability to maintain ion homeostasis. Elevated frequencies of vertebral deformations in fish exposed to BKME confirm previous observations of vertebral damage in feral fourhorn sculpin caught in the receiving body of water of the same bleached kraft pulp industry. Many of the parameters analyzed in this investigation may be used as health indicators in future laboratory and field studies on fish exposed to BKME. (Author's abstract) (See also W88-07472)
W88-07475

APPLICATION OF NONLINEAR OPTIMIZATION TO WATER QUALITY,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-07492

EFFECTS OF CHEMICAL STRESS ON THE POPULATION DYNAMICS OF DAPHNIA MAGNA: A COMPARISON OF TWO TEST PROCEDURES,
Ministry of Transport and Public Works, Lelystad (Netherlands). Lab. for Ecotoxicology.
C. J. Van Leeuwen, G. Niebeek, and M. Rijkeboer.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 1-11, August 1987. 5 fig, 5 tab, 20 ref.

Descriptors: *Water pollution effects, *Growth rates, *Daphnia, *Toxicity, *Population exposure, *Fertility, Heavy metals, Organic compounds, Population dynamics, Crustaceans.

Ten substances were tested to compare two methods that can be used in chronic toxicity studies with the Cladoceran Daphnia magna. In semistatic experiments with cohorts (life-table studies) survival appeared to be a dominant factor in exponential population growth. Specific inhibition of reproduction as a result of toxic stress was observed only in tests with bromide and 2,4-dichloroaniline. For some substances (cadmium, bichromate, metavanadate, and bromide) individual growth (carapace length) was found to be a sensitive parameter. In intermittent-flow experiments with small expanding populations the yield (carrying capacity) proved to be a highly sensitive parameter, probably owing to the fact that in these tests populations grow logistically, i.e., become additionally stressed by food limitation. Chemically induced reductions in food ingestion and conversion efficiency may thus become very predominant. In view of the place of these crustaceans in the food web such reductions in the carrying capacity would seem to be of great ectoxicological importance. (Author's abstract)
W88-07495

TOXICITY OF NICKEL AND SILVER TO NOSTOC MUSCORUM: INTERACTION WITH ASCORBIC ACID, GLUTATHIONE, AND SULFUR-CONTAINING AMINO ACIDS,
Banaras Hindu Univ., Varanasi (India). Centre for Advanced Study in Botany.
L. C. Rai, and M. Raizada.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 12-21, August 1987. 3 fig, 3 tab, 18 ref.

Descriptors: *Nostoc, *Water pollution effects, *Toxicity, *Population exposure, *Morbidity, *Nickel, *Silver, Metabolism, Enzymes, Amino acids, Detoxification, Bacteria, Cyanophyta.

Exposure of Nostoc muscorum to different concentrations of Ni and Ag brought about reductions in growth, carbon fixation, heterocyst production,

and nitrogenase activity and increase in the loss of ions (K+, Na+). In an attempt to ameliorate the toxicity of test metals by ascorbic acid, glutathione, and sulfur-containing amino acids (L-cysteine and L-methionine), it was found that the level of protection by ascorbic acid and glutathione was more for Ag than Ni. However, metal-induced inhibition of growth and carbon fixation was equally ameliorated by methionine. But the level of protection by cysteine was quite different, i.e., 27% for Ni and 22% for Ag. Protection of metal toxicity in N. muscorum by amino acids lends further support to self-detoxifying ability of cyanobacteria because they are known to synthesize all essential amino acids. (Author's abstract)
W88-07496

GAMMA-BHC- AND CYTHION-INDUCED ALTERATIONS IN LIPID METABOLISM IN A FRESHWATER CATFISH, CLARIAS BATRACHUS, DURING DIFFERENT PHASES OF ITS ANNUAL REPRODUCTIVE CYCLE,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
B. Lal, and T. P. Singh.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 38-47, August 1987. 4 fig, 30 ref. Grant-in-aid for research from HCS/DST/928/80 and ICAR-PL-480 Project Now. INARS-213, New Delhi.

Descriptors: *Fertility, *Chlorinated hydrocarbons, *Melathion, *Water pollution effects, *Metabolism, *Catfish, *Pesticides, Population exposure, Biological studies, Spawning, Chemical effects, Fish physiology.

Specimens of either sex of the freshwater catfish Clarias batrachus were exposed to safe and sublethal concentrations of gamma-BCH (1,2,3,4,5,6-hexachlorocyclohexane) (2 and 8 ppm) and Cythion (malathion) (1 and 4 ppm) for 4 wk during different phases of the annual reproductive cycle. Their effects on various lipid fractions, viz., triglycerides (TG), phospholipids, free cholesterol, and esterified cholesterol, were studied in liver, plasma, gonads, and muscle. These pesticides suppressed the level of hepatic TG in females during the preparatory, prespawning, and postspawning phases, while during the spawning phase they stimulated an increase in its level. However, in males, these pesticides were ineffective in having any effect on liver TG during the spawning and postspawning phases, but in the preparatory phase, as with the female, they increased its levels, while in the prespawning phase they decreased liver TG levels. Hepatic phospholipid biosynthesis was impaired by gamma-BHC but cythion had no effect on it. Cholesterol biosynthesis as such appeared to be unaffected by these pesticides but the dynamics of free and esterified cholesterol levels were disturbed in response to Cythion and gamma-BHC. These pesticides greatly reduced the mobilization of these hepatic lipids to gonads. Muscle lipids were least affected by these pesticides. (Author's abstract)
W88-07498

EFFECT OF SAFE CONCENTRATIONS OF SOME PESTICIDES ON TESTICULAR RECRUDESCENCE IN FRESHWATER MURREL, CHANNA PUNCTATUS (BL.): A MORPHOLOGICAL STUDY,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
P. K. Saxena, and K. Mani.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 56-63, August 1987. 12 fig, 1 tab, 20 ref.

Descriptors: *Water pollution effects, *Population exposure, *Fertility, *Organic pesticides, *Fish, Spawning, Chemical effects, Biological studies, Morbidity, Organophosphorus pesticides, Carbamate pesticides.

The effects of safe concentrations of fenitrothion 50% E.C., an organophosphate, and carbofuran 3%, a carbamate, on testicular recrudescence of Channa punctatus during the maturing, prespawning, and spawning phases (15th April through 12th August, 1980) of the annual reproductive cycle have been studied. The results reveal that compared to the carbofuran treatment, the fenitrothion treatment was more effective in lowering testicular weights. Furthermore, the carbofuran treatment delayed the formation of spermatids and sperm, since their occurrence in the testes was observed at 90 days of exposure, but at 60 days of exposure in the control fish. The fenitrothion treatment not only delayed the formation of spermatids, but also arrested the formation of sperm, since most of the spermatids had undergone necrosis. The exposure for 120 days to safe concentrations of carbofuran/fenitrothion also resulted in the necrosis of spermatogonia and spermatogenetic stages were observed in the testes of the treated fish. The occurrence of such empty lobules, however, was relatively greater in the fenitrothion-treated fish. The formation of the collagenous capsules around the necrotic germ cells was also observed in the treated fish testes. The interstitial (Leydig) cells were in the involuted condition in the treated fish testes, but active in the control fish. (Author's abstract)
W88-07499

FATHEAD MINNOW FHM CELLS FOR USE IN IN VITRO CYTOTOXICITY ASSAYS OF AQUATIC POLLUTANTS,
Rockefeller Univ., New York. Lab. Animal Research Center.
For primary bibliographic entry see Field 5A.
W88-07500

UPTAKE AND LOSS OF DISSOLVED CADMIUM BY THE STICKLEBACK, GASTEROSTEUS ACULEATUS L.,
Queen Elizabeth Coll., London (England).
J. A. O. Oronsaye.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 88-96, August 1987. 7 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Population exposure, *Metabolism, *Absorption, *Bioaccumulation, *Cadmium, *Zinc, *Fish populations, Heavy metals, Stickleback.

The whole-body uptake of cadmium by the three-spined stickleback (Gasterosteus aculeatus) has been measured after exposure of fish to 2.5 and 5.0 mg Cd(2+)/liter hard water and equal amounts of 2.0 mg Cd(2+) plus 2 mg Zn(2+)/leter and 4.0 mg Cd(2+) plus 4.0 mg Zn(2+)/liter hard water, respectively. Fish absorbed and retained cadmium while the uptake and accumulation of zinc was depressed. The loss of absorbed cadmium was quicker in fish previously exposed to cadmium plus zinc solutions used together. Cadmium depresses the uptake zinc when present together. Since zinc is an essential element, its displacement will induce a state of zinc deficiency. It is conceivable that even though cadmium may be lost to fish after exposure to cadmium and zinc together, the bound cadmium not lost may continue to displace more zinc and this may eventually kill the fish through cadmium poisoning. (Freidmann-PTT)
W88-07501

EVALUATION OF THE GREAT LAKES NEARSHORE INDEX,
Dept. of Environmental Health, College of Public Health, P.O. Box 26901, Oklahoma City, OK 73190.
For primary bibliographic entry see Field 2H.
W88-07537

COMMUNITY DEGRADATION INDEX: A NEW METHOD FOR ASSESSING THE DETERIORATION OF AQUATIC HABITATS,
Estuaries and Coastal Processes Division, The National Institute for Water Research, P.O. Box 17001, Congella 4036, Republic of South Africa.
A. E. Ramm.
Water Research WATRAG, Vol. 22, No. 3, p 293-301, March 1988. 5 fig, 1 tab, 22 ref.

Descriptors: *Water pollution effects, *Streams, *Aquatic habitats, *Pollution index, *Degradation, Habitats, Fish, Community degradation index, Cuyahoga River, Ohio, Species diversity, Species composition, Model studies.

The community degradation index was developed as a simple method for evaluating stream habitats by comparing them with a theoretical (ideal) situation. No degradation was indicated by 0; total degradation, by 10. The concept and mathematical expression of this index was new. It was designed to eliminate subjective decision making regarding the sensitivity of a particular species of biological assemblage to a pollutant or mix of pollutants. When applied to data from the Cuyahoga River, Ohio, close agreement was obtained between community degradation as expressed by the index and field observations. The Cuyahoga Basin, known as a polluted area, had a high index of 6.0 (range, 9.3 in the main stem to 2.1 in the upper reaches), compared with a rural river 30 miles to the east, with an index of 3.4. The river reaches with the highest index numbers were those into which waste is commonly discharged. (Cassar-PTT)
W88-07540

FAILURE OF SPRING TURNOVER IN ONONDAGA LAKE, NY, U.S.A.,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and M. G. Perkins.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 285-291, July 1987. 3 fig, 13 ref.

Descriptors: *Onondaga Lake, *Limnology, *Turnover, *Oxygen depletion, *Water pollution effects, Ice-water interfaces, Alkaline water, Industrial wastewater, Lakes, Ice breakup.

Onondaga Lake, N.Y., failed to turnover in the spring of 1986 because of the strong chemical stratification under the ice that developed as a result of ionic discharges from an alkali plant. This stratification had a negative impact on the O2 resources of the lake, as the lower depleted layers of the lake were not replenished with O2. Anoxia and anaerobiesis in the bottom water expanded following 'ice-out'. Comparison of characteristics observed for the winter through spring interval of 1986 with historic data indicates Onandaga Lake has failed to experience spring turnover in a number of years (approximately 7 of the last 18 yr) because of the ionic discharges from the alkali plant. (Author's abstract)
W88-07591

ACID PULSES FROM SNOWMELT AT ACIDIC CONE POND, NEW HAMPSHIRE,
IEP, Inc., Northborough, MA.
S. F. Baird, D. C. Buso, and J. W. Hornbeck.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 325-338, July 1987. 7 fig, 1 tab, 31 ref.

Descriptors: *Seasonal variation, *Acid pulses, *Snowmelt, *Cone Pond, *Limnology, *Water pollution effects, *Acid rain, Water chemistry, Hydrogen ion concentration, Pollution load, Snow, Ponds, Thaw, Sulfates, Aluminum, Nitrates, Slush, Ice, Alkaline water, Acidic water.

A study was undertaken to examine whether 'acid pulses' from snowmelt created permanent changes in a pond's chemistry. Water samples were collected from clearwater acidic Cone Pond in the White Mountain National Forest, New Hampshire. The pond, inlet, and outlet were intensively sampled throughout winter and early spring 1983-84. Thaws brought more H(+) into upper waters of the pond, but most was gone within a week. In contrast, SO4(2-) and Al showed dilution with increased streamflow into the pond, and NO3(-) was only detected in ice, slush, and surface waters. Bottom waters were anoxic throughout the winter and had pH 6.0 compared to 4.7 for most of the water column. Alkalinity at the bottom rose from 0 in November 1983 to 190 micro-eq/L in April 1984. Between November and April the pond gained Al but lost SO4(2-) and H(+). Most of the Al gain came after ice-out when loading through the inlet increased, but during the final snowmelt a temporary increase in Al concentration was also seen throughout the water column. (Author's abstract)

W88-07594

HEMATOLOGICAL AND PATHOLOGICAL EFFECTS OF CHROMIUM TOXICOSIS IN THE FRESHWATER FISH, BARBUS CONCHONIUS HAM,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
T. S. Gill, and J. C. Pant.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 241-250, October 1987. 16 fig, 2 tab, 20 ref.

Descriptors: *Water pollution effects, *Chromium, *Tissue analysis, *Toxicity, *Fish, Animal physiology, Population exposure, Heavy metals, Animal pathology, Hematology, Blood.

Experimental exposure to Cr(VI) induced anomalies in the peripheral blood and tissues of a freshwater fish, Barbus conchonius. Clinical findings in the blood corpuscles included swelling of erythrocytes, numerous circulating polychromatophils, and vaculation of large lymphocytes during acute exposure. Poikilocytosis, severe cytoplasmic vacuolation and deterioration of cytoplasmic membrane in erythrocytes occurred following chronic exposure. Significant polycythemia with collateral rise in hemoglobin (Hb) and hematocrit (Hct) were manifest in the acutely intoxicated fish. By contrast, chronic exposure caused marked erythropenia and an accompanying reduction in Hb and Hct values. Leucocyte subpopulations showed an initial rise and then a fall in the thrombocytes together with a significant lymphocytosis, neutropenia, and basophilia. Pathological changes were observed in the gills, kidneys, and liver of Cr-exposed fish. (Author's abstract)
W88-07601

TRACE METALS IN FISH EXPOSED TO ASBESTOS RICH SEDIMENTS,
British Columbia Univ., Vancouver. Westwater Research Centre.
For primary bibliographic entry see Field 5B.
W88-07603

BEHAVIORAL RESPONSES OF A MARINE BIVALVE (VENUS VERRUCOSA) TO POLLUTION BY PETROLEUM HYDROCARBONS,
Malta Univ., Msida. Dept. of Mathematics and Science.
V. Axiak, and J. J. George.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 395-410, October 1987. 7 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Bivalves, *Hydrocarbons, *Clams, Tissue analysis, Population exposure, Animal physiology, Animal pathology, Oil.

The effects of exposure to petroleum hydrocarbons (PHC) on the burrowing behavior, valve activities and siphonal and foot reactions of the clam, Venus verrucosa were investigated in a series of laboratory experiments. Such exposure did not significantly alter the burrowing activities of this species. The foot, siphons and mantle folds failed to respond both to low and high concentrations of PHC. After 130 day of exposure to 100 micrograms/L of water-accommodated fractions of oil, both the response time and the recovery period of the siphonal response to light stimuli were significantly prolonged. Increased valve activities were also recorded. This suggests that exposure to oil interferes with the animal's normal neurophysiological activities. Increase valve opening resulted in more intimate exposure of the body parts to oil which produces important deleterious effects on this species. (Alexander-PTT)
W88-07607

BULK SEDIMENT BIOASSAYS WITH FIVE SPECIES OF FRESH-WATER OLIGOCHAETES,
National Swedish Environmental Protection Board, Environmental Quality Lab., Freshwater Section, Box 8005, S-750 08 Uppsala, Sweden.
T. Wiederholm, A.-M. Wiederholm, and G. Milbrink.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 131-154, November 1987. 8 fig, 5 tab, 33 ref.

Descriptors: *Lake sediments, *Water pollution effects, *Tubificids, *Analytical methods, *Population exposure, *Toxicity, *Bioassay, *Oligochaetes, Animal physiology, Microbiological studies, Reproduction, Heavy metals, Trophic level, Food habits, Lakes, Sediments.

A semistatic test procedure was developed to measure the toxicity of contaminated sediments. Tubifex tubifex, Limnodrilus hoffmeisteri, L. udekemianus, L. claparedeanus, and Potamothrix hammoniensis were cultured in unpolluted and variously polluted lake sediments for 0.5 to 1.5 yr at 20 deg C with and without additions of food. Growth and reproduction were generally affected earlier than survival in sediments polluted by heavy metals. The worms were generally much more sensitive to pollutants in sediments from oligotrophic to mesotrophic lakes than in those from eutrophic lakes. Addition of food weakened the response to pollutants. (Author's abstract)
W88-07611

EFFECT OF TOXICANTS ON ALGAL SINKING RATES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. M. Pekkala, and B. Koopman.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 1/2, p 155-162, November 1987. 4 fig, 1 tab, 27 ref.

Descriptors: *Water pollution effects, *Analytical methods, *Toxicity, *Scenedesmus, *Chlorine, *Copper, *Algae control, Water treatment, Wastewater treatment, Population exposure, Algae, Flocculation.

A fluorometric technique was used to measure sinking rates of Scenedesmus acuminatus following exposure to Cl and Cu. Observed rates became larger in proportion to chemical dosage. The maximum values were 6.4 x ambient at 7.5 g/cu m chlorine and 7.0 x ambient at 40 g/cu m Cu. In comparison, a maximum increase in sinking rate of 5.4 x ambient was achieved with 49 g/cu m alum. Microscopic observations indicated that cell lysis and flocculation resulted from exposure of algal cells to toxicants. (Author's abstract)
W88-07612

EFFECTS OF SEDIMENT AND CONTAMINATED SEDIMENT ON STRUCTURAL AND FUNCTIONAL COMPONENTS OF EXPERIMENTAL STREAM ECOSYSTEMS,
National Fisheries Contaminant Research Center, Columbia, MO.
J. F. Fairchild, T. Boyle, W. R. English, and C. Rabeni.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 3/4, p 271-293, December 1987. 10 fig, 5 tab, 59 ref. EPA Interagency Agreement 14-16-0009-81-957.

Descriptors: *Water pollution effects, *Limnology, *Sediments, *Streams, Biodegradation, Primary productivity, Population dynamics, Population dynamics, Macroinvertebrates, Species composition, Leaves, Litter, Invertebrates, Benthos, Aquatic habitats, Ecological effects, Insects, Nutrients.

Three experimental stream ecosystems were used to determine the effects of sediment and contaminated sediment: one stream received 1.7 g/L uncontaminated sediment for 2 hr each week for 3 wk; one stream received 1.7 g/L contaminated sediment (50 to 1600 ppm triphenyl phosphate applied in increasing doses each week) for 2 hr each week for 6 wk; and the third stream was maintained as a control. Each stream was monitored for changes in nutrient dynamics, leaf decomposition, primary production, and invertebrate dynamics. Both sediment and sediment/triphenyl phosphate altered the drift dynamics of benthic invertebrates. Invertebrates in the sediment treatment exhibited delayed nocturnal drift, while those on the sediment/triphenyl phosphate treatment drifted immediately once a threshold of toxicity was reached. Both sediment and sediment/triphenyl phosphate decreased the percent similarity of benthic invertebrates, reduced the drift of filamentous algae, increased the production of rooted flora, and increased net nutrient retention. However, neither treatment altered leaf decomposition rates, nor affected benthic invertebrate dynamics (total number, number of species, or diversity) or insect emergence. (Author's abstract)
W88-07618

PHYSIOLOGICAL RESPONSE OF BROWN TROUT (SALMO TRUTTA) SPAWNERS AND POSTSPAWNERS TO ACIDIC ALUMINUM-RICH STREAM WATER,
Oslo Univ. (Norway). Dept. of Biology.
I. P. Muniz, R. Andersen, and T. J. Sullivan.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 3/4, p 371-379, December 1987. 4 fig, 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Acidic water, *Trout, *Fish physiology, *Aluminum, Streams, Population exposure, Water quality, Limnology, Tissue analysis, Survival, Stress.

High immediate postspawning mortality due to inferior autumn water quality has been hypothesized to cause juvenilization in some brown trout populations in acidified areas. Male and female spawners and female postspawners from a juvenile-dominated brown trout population were exposed to acidic streamwater (pH = 4.83, Al sub i = 240 micrograms/L) and a limed control (pH = 5.70, Al sub i = 55 micrograms/L) for 28 days in November and December, 1984. Water chemistry was monitored at least bi-daily, and physiological stress was assessed by analysis of plasma chloride, osmolality and hematocrit. Neither pronounced physiological stress nor mortality was observed at the control site. At the exposure site trout showed significant but moderate stress responses and 15% died. The results are discussed in terms of potential population effects and physiological mechanisms, e.g., plasma volume reduction. (Author's abstract)
W88-07620

BIOMONITORING OF LOW LEVELS OF MERCURIAL DERIVATIVES IN WATER AND SOIL BY ALLIUM MICRONUCLEUS ASSAY,
Berhampur Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5A.
W88-07637

LATENT EFFECTS OF PULSE EXPOSURE TO ALUMINUM AND LOW PH ON SIZE, IONIC COMPOSITION, AND FEEDING EFFICIENCY OF LAKE TROUT (SALVELINUS NAMAYCUSH) ALEVINS,
Guelph Univ. (Ontario). Dept. of Zoology.
J. M. Gunn, and D. L. G. Noakes.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 8, p 1418-1424, August, 1987. 3 fig, 2 tab, 49 ref. Nat. Res. Council of Canada Contract No. DSS 20ST 31048-4-200.

Descriptors: *Aluminum, *Hydrogen ion concentration, *Acidity, *Water pollution effects, *Chemical composition, *Ions, *Predation, *Trout, *Acid rain, *Acidic water, *Lakes, Fish, Mortality, Life stages, Embryonic life stage, Tissue analysis, Growth, Daphnia, Crustaceans.

No mortality of lake trout (Salvelinus namaycush) embryos occurred during 5 d of exposure to aluminum concentrations of 0, 100, and 200 micrograms/L in low-pH (pH 5.0) water or during 21- and 32-d recovery periods, but alevins from the high-Al exposure were smaller in length, had less calcified skeletons, had reduced (18-22%) whole-body concentrations of Ca(++) and K(+), and were less effective predators on Daphnia magna. These latent effects of pulse exposure to acidic Al-rich water may help explain the disappearance of lake trout populations from lakes with relatively high ambient pH. (Author's abstract)

W88-07639

EMPIRICAL MODELS OF FISH RESPONSE TO LAKE ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow, R. W. Black, T. B. Stockton, J. D. Vogt, and J. G. Wood.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 8, p 1432-1442, August, 1987. 9 fig, 8 tab, 25 ref. EPA Contract No. CR- 811837-01-0.

Descriptors: *Water pollution effects, *Adirondacks, *Acidity, *Acid rain, *Lakes, *Trout, *Sucker, *Perch, *Statistical models, Model studies, Rainfall, Fish, Regression analysis, Chemical properties.

A large historical data set from the Adirondack region of New York was compiled to study the relationship between water chemistry variables associated with acid precipitation and the presence/absence of selected fish species. The data set was used to examine simple statistical models for fish presence/absence, as a function of the water chemistry variables, for brook trout (Salvelinus fontinalis), lake trout (Salvelinus namaycush), white sucker (Catostomus commersoni), and yellow perch (Perca flavescens). Of these models, only those for brook trout and lake trout were found to be acceptable based on statistical goodness-of-fit criteria. Thus, parameters for models of these two species alone were estimated using maximum likelihood logistic regression. Candidate models for brook trout and lake trout were then examined, with particular consideration for the problems associated with model misspecification, errors-in-variables, and multicollinearity. For each of the two species, a model was recommended that may be used to predict the effect of changes in lake acidification on species presence/absence in lakes in the Adirondack region. (Author's abstract)
W88-07640

RESPONSES OF JUVENILE ATLANTIC SALMON (SALMO SALAR) TO EPISODIC INCREASES IN ACIDITY OF NOVA SCOTIA RIVERS,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
G. L. Lacroix, and D. R. Townsend.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 8, p 1475-1484, August, 1987. 8 fig, 2 tab, 42 ref.

Descriptors: *Juvenile life stage, *Salmon, *Water pollution effects, *Acid rain, *Acidity, *Nova Scotia, *Rivers, *Toxicity, Life stages, Fish, Hydrogen ion concentration, Mortality, Tissue analysis, Sodium, Chlorides, Animal physiology, Fish physiology, Aluminum, Gills.

Toxicity of different pH levels to Atlantic salmon (Salmo salar) parr held in floating pens for 54 d was assessed in four acidic streams of Atlantic Canada during the autumnal episode of increasing acidity. All parr died in the two streams where pH levels decreased below pH 4.7. Mortality was related to the rate of pH change and to parr size. Plasma sodium and chloride concentrations decreased by about 50-70 mmol/L in parr of these two streams, and the rate of electrolyte loss was related to the rate and severity of pH change. In the other two streams, pH levels were never lower than pH 4.8 and no fish died. Plasma sodium and chloride concentrations in these parr decreased by 20-30 mmol/L, but only after 30 d of exposure. Increased hematocrit, increased respiratory-cough response, and decreased feeding response, especially for parr in the most acidic streams, were also the result of stress apparently related to decreasing pH levels. Concentrations of labile aluminum were usually <10% of total dissolved aluminum and always <50 micrograms/L in the four streams. Accumulation of aluminum in the gills of parr was not a significant factor in the lethal effects observed, which were more likely due to low pH. (Author's abstract)
W88-07642

ROLE OF SPHAGNUM FIMBRIATUM IN SECONDARY SUCCESSION IN A ROAD SALT IMPACTED BOG,
Indiana Dunes National Lakeshore, Porter, IN.
D. A. Wilcox, and R. E. Andrus.
Canadian Journal of Botany CJBOAW, Vol. 65, No. 11, p 2270-2275, November, 1987. 1 fig, 6 tab, 33 ref.

Descriptors: *Succession, *Mosses, *Roads, *Salt, *Salt tolerance, *Bogs, *Deicers, *Water pollution effects, Wetlands, Ecology, Toxicity, Peat, Peat bogs, Interstitial water, Chlorides, Spores.

Secondary succession of Sphagnum mosses was studied for 7 yr along a belt transect in a bog that had been exposed to sodium chloride highway deicing salts. Laboratory studies on Sphagnum fimbriatum, the dominant recolonizing species, were conducted to determine its salt tolerance level and ability to reproduce from spores and fragments across a salt gradient. Vegetative reproduction was also compared with that of four other recolonizing species. Sphagnum fimbriatum represented a high percentage of all recolonizing Sphagnum and generally began growing on low hummocks in quadrats where the salt content of the interstitial peat pore waters had dropped to about 300 mg/L as chloride. This salt concentration was also found to be the basic tolerance limit for mature plants and reproducing spores and fragments. The success of Sphagnum fimbriatum as a pioneer species seems to be associated with its prolific and probable dispersal of spores, its superior vegetative reproduction, its tolerance of mineralized waters, and its ability to grow on hummocks out of direct contact with mineralized waters. (Author's abstract)
W88-07643

UNIONID MUSSELS (MOLLUSCA, BIVALVIA) OF THE BELGIAN UPPER RIVER MEUSE: AN ASSESSMENT OF THE IMPACT OF HYDRAULIC WORKS ON THE RIVER WATER SELF-PURIFICATION,
Liege Univ. (Belgium). Zoology Inst.
For primary bibliographic entry see Field 6G.
W88-07670

ENVIRONMENTAL DEGRADATION IN THE PANTANAL ECOSYSTEM,
Laboratorio de Zoologica e Ecologia Animal, Departamento de Biologia Animal, Universidase de Brasilia, Brasilia, DF, 70910, Brazil.
For primary bibliographic entry see Field 4C.
W88-07671

EFFECTS OF SULPHUR DIOXIDE AND ACID RAIN ALONE OR IN COMBINATION ON GROWTH AND YIELD OF BROAD BEAN PLANTS,
Institut fur Produktions- und Okotoxicologie, Bundesforschungsanstalt fur Landwirkschaft, Bundesallee 50, D-3300 Braunschwieg, Federal Republic of Germany.
G. Adaros, H. J. Weigel, and H.-J. Jager.
New Phytologist NEPHAV, Vol. 108, No. 1, p 67-74, January 1988. 3 tab, 40 ref.

Descriptors: *Water pollution effects, *Air pollution effects, *Acid rain, *Sulfur dioxide, *Beans, *Plant growth, *Crop yield, Sulfur compounds, Hydrogen ion concentration, Plant tissues, Rainfall, Plant physiology.

Potted plants of Vicia faba L. cv. 'Con Amore', grown either in soil or quartz gravel were exposed in eight open-top chambers to two levels of SO2 (charcoal-filtered air and charcoal-filtered air enriched with SO2) and two artificial rain treatments (pH 5.6 and pH 3.0/4.0), alone or in combinations. SO2 was dosed continuously (55-90 micrograms/cu mm for 56 days) and rain solutions were applied on three days each week for 8-9 minutes each day resulting in 4.45 mm rainfall per week and a total H(+) deposition of 0.15 kg/ha and a total water deposition of 37 mm. Variables measured at different stages of plant development included fresh and dry weight of whole plants, leaves, stalks, fruits and roots; number of leaves, stalks, blossoms, pods and seeds; leaf area; plant height; and sulfur content. While sulfur content of the leaves of all plants significantly increased due to the SO2 fumigation, the effect on growth of young plants depended on the root medium; plants grown in soil were mainly influenced in a positive manner (increase of fresh and dry weight; number of leaves, blossoms and pods), whereas plants grown in quartz gravel were negatively affected. At maturity these tendencies were only observed in marketable products like seeds (plants grown in soil) or pods (plants grown in quartz gravel). The acid-rain treatment resulted in a decrease of total fresh and dry weight and fruit production of plants grown in soil, while, particularly at the beginning of the rain treatments, dry weight of whole plants and leaves as well as the number of leaves of plants grown in quartz gravel decreased. Some interactions between the two pollutants, which were mostly negative in nature, were also observed. (Author's abstract)
W88-07688

EFFECTS OF SIMULATED ACID RAIN ON LEAF WETTABILITY, RAIN RETENTION AND UPTAKE OF SOME INORGANIC IONS,
Bristol Univ. (England). Dept. of Agricultural Sciences.
K. E. Percy, and E. A. Baker.
New Phytologist NEPHAV, Vol. 108, No. 1, p 75-82, January 1988. 6 fig, 2 tab, 47 ref.

Descriptors: *Acid rain, *Water pollution effects, *Plant physiology, *Leaves, Beans, Peas, Rape, Hydrogen ion concentration, Simulated rainfall, Ions, Cations, Anions, Radioisotopes, Ruthenium radioisotopes, Sulfur radioisotopes, Nickel radioisotopes, Wettability, Dyes, Tracers.

Leaves of Phaseolus vulgaris L., Vicia faba L., Pisum sativum L. and Brassica napus L. were exposed from emergence to full expansion to seven treatments of simulated acid rain at pH values between 5.6 and 2.6. Droplet leaf angles in all species decreased on leaves exposed to simulated acid rain at pH less than or equal to 4.6 relative to those exposed at pH 5.6. Retention of rain containing fluorescein increased on P. vulgaris leaves exposed to simulated acid rain at pH 4.6 and at pH less than or equal to 3.8. Retention by B. napus leaves was increased at pH less than or equal to 4.6. Uptake of the three ions studied was in the order Rb86(+) > S35O4(2-) > Ni63(2+). Uptake of Rb86(+) increased into B. napus leaves and decreased into P. vulgaris leaves exposed at pH less than or equal to 3.4. Uptake of S35O4(2-) and Ni63(2+) by B. napus leaves increased after exposure to simulated acid rain at pH 2.6 but it was unaffected in P. vulgaris. Up to 7% of applied S35O4(2-) was found in the epicuticular wax layer on B. napus leaves 48 hours after application, most being found after exposure at pH 2.6. The order of lateral movement of ions within leaves paralleled the order of uptake. Movement of all three ions was increased in B. napus leaves exposed previously to simulated acid rain at pH 2.6. The increased retention of fluorescein on leaves exposed to simulated acid rain and the reduced contact angles for water are attributed to decreases in surface roughness. The altered ion uptake pattern could also be related to changes in surface wax structure or could be associated with observed changes in properties of cuticular membranes. These results demonstrate that the interaction of plants with their atmospheric environment could be afected by pre-exposure to acid rain in amounts and at pH values that occur in ambient rainfall. (Author's abstract)
W88-07689

EFFECTS OF SULPHUR DIOXIDE AND NITROGEN DIOXIDE ON THE CONTROL OF WATER LOSS BY BIRCH (BETULA SPP.),
Lancaster Univ. (England). Dept. of Biological Sciences.
E. A. Neighbour, D. A. Cottam, and T. A. Mansfield.
New Phytologist NEPHAV, Vol. 108, No. 2, p 149-157, February 1988. 10 fig, 2 tab, 19 ref.

Descriptors: *Air pollution effects, *Water loss, *Birch trees, *Sulfur dioxide, *Nitrogen dioxide,

Trees, Leaves, Plant tissues, Pollutants, Stomata, Transpiration, Water stress, Carbon dioxide, Water use efficiency, Plant pathology, Electron microscopy.

The effects of SO2 and NO2 on the control of water loss by birch trees were investigated using clonal populations of both Betula pendula Roth. (silver birch) and Betula pubescens Ehr. (downy birch). Plants were grown in controlled environments and were fumigated in a 2x2 factorial experiment with 65 nl/l SO2 and/or NO2, or with equal concentrations of both SO2 and NO2 in four treatments, namely zero, 20, 40, and 60 nl/l. Excised leaves showed an increased rate of water loss approximately corresponding to the concentration of pollutant to which they had been previously exposed. When petroleum jelly was applied to the abaxial epidermal surface of polluted leaves the increased rate of water loss was not found, strongly implying that the damage had occurred only at this site, and not on the adaxial epidermis, which is virtually devoid of stomata. Measurements of gas exchange were made on B. pubescens exposed to the four doses of the mixture of the two gases. The rate of transpiration was approximately doubled as a result of the two higher pollution treatments, judging from measurements made later in clean air. When transpiration was measured in high and low CO2 concentrations, polluted plants had a slightly reduced and more variable response to the change in CO2 concentration. Both clones were also exposed to the four doses of the gas mixture, and then to drought. There was a more rapid onset of water stress, accompanied by an earlier decrease in effective leaf area in the polluted plants, when compared with the unpolluted plants. The abaxial surface of frozen hydrated leaves of the Betula pubescens clone were examined at low temperature with a scanning electron microscope. Damaged epidermal cells were clearly visible on the polluted leaves and thought to be responsible for areas of wide open stomata. It is concluded that leaves of these species are less efficient in the utilization of water after a period of exposure to pollution and are less able to restrict water loss in a time of shortage. (Author's abstract)
W88-07690

MORPHOLOGIC LESIONS AND ACUTE TOXICITY IN RAINBOW TROUT (SALMO GAIRDNERI) TREATED WITH 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Department of Veterinary Pathology, Cornell University, Ithaca, New York.
J. M. Spitsbergen, J. M. Kleeman, and R. E. Peterson.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 23, No. 3, p 333-358, March 1988. 9 fig, 4 tab, 47 ref. National Oceanic and Atmospheric Administration Grant NA84AA-D-00065. University Sea Grant Projects R/MW-27 and R/MW-40. NIEHS Grants ES01985 and ES01332. NIEHS Training Grants ES07105 and ES07015.

Descriptors: *Chlorinated dibenzodioxins, *Water pollution effects, *Trout, *Fish, *Fish physiology, Fish handling facilities, Stress, Toxicity, Growth, Mortality, Lethal limit, 2,3,7,8-tetrachlorodibenzo-p-dioxin, Pollutants, Dioxins, Fish diseases.

To determine effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) on growth, mortality, and morphologic lesions in rainbow trout, juvenile Shasta or Wytheville strain fish, obtained from 4 hatcheries, were administered graded single doses of TCDD, 0.1-125 micrograms (ug)/kg, ip. TCDD doses of 25 and 125 ug/kg caused 85% lethality 2-4 wk after treatment. At these high doses, death occurred before body weight loss could be detected. A lower dose of 5 ug/kg caused decreased growth and cumulative mortality of 20% after 11 wk. Stress associated with netting and weighing the fish at weekly intervals significantly shortened the delay prior to TCDD-induced lethality. Gross and microscopic lesions were evident in rainbow trout treated with 10 ug/kg TCDD/kg, but not in fish treated with 1 or 0.1 ug/kg. Morphologic lesions occurred consistently in epithelial and lymphomyeloid tissues of TCDD-treated fish. The severity and character of lesions in the liver and gastric mucosa varied markedly between hatchery strains of trout. One hatchery strain showed no hepatic lesions, two showed mild hepatocyte lesions, and one exhibited severe diffuse hepatopathy. One of the 4 hatchery strains showed atrophy of serous gastric glands and 1 of 4 hatchery strains showed hyperplasia of these same glands at 25 and 34 d, respectively, following TCDD treatment. Thus, lymphomyeloid and epithelial tissues are the primary targets for TCDD-induced pathologic lesions in rainbow trout, and the incidence and severity of these lesions is influenced by the strain of trout used and the hatchery from which the trout were obtained. (Author's abstract)
W88-07706

2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN TOXICITY IN YELLOW PERCH (PERCA FLAVESCENS),
Department of Veterinary Pathology, Cornell University, Ithaca, New York.
J. M. Spitsbergen, J. M. Kleeman, and R. E. Peterson.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 23, No. 3, p 359-383, March 1988. 12 fig, 2 tab, 36 ref. National Oceanic and Atmospheric Administration Grant NA84AA-D-00065. University Sea Grant Projects R/MW-27 and R/MW-40. NIEHS Grants ES01985 and ES01332. NIEHS Training Grants ES07105 and ES07015.

Descriptors: *Chlorinated dibenzodioxins, *Water pollution effects, *Perch, *Dioxins, *Toxicity, *Fish, *Fish physiology, Fish handling facilities, Stress, Growth, Mortality, 2,3,7,8-tetrachlorodibenzo-p-dioxin, Pollutants, Dioxins, Fish diseases, Lethal limit, .

Growth, mortality and morphologic lesions in juvenile, hatchery-reared yellow perch, Perca flavescens, were studied after treatment with graded single doses of 2,3,7,8-tetrachlordibenzo-p-dioxin (TCDD, 1-125 micrograms (ug)/kg, intraperitoneally). TCDD doses of 25 and 125 ug/kg caused 95% mortality by 28 d after treatment, without decreasing body weight. A TCDD dose of 5 ug/kg resulted in progressive loss of body weight with cumulative mortality of 80% by 80 d posttreatment. Periodic handling stress did not affect the time course of mortality or cumulative percent lethality in TCDD-treated perch. Fin necrosis, petechial cutaneous hemorrhage, and ascites occurred in perch treated with 5 ug/kg of more of TCDD. Thymic atrophy, decreased hematopoiesis in the head kidney, fibrinous pericarditis, focal myocardial necrosis, submucosal gastric edema, and hyperplasia of the epithelium of gill filaments and lamellae occurred in perch dosed with 25 or 125 ug/kg. Dose-related splenic lymphoid depletion occurred in perch receiving 5 ug/kg or more TCDD, and hepatocyte lipidosis occurred in groups treated with doses of 1 ug/kg or more TCDD. Thus, yellow perch are as responsive to the acute effects of TCDD as some of the more sensitive mammalian species, and neither loss of body weight nor histologic lesions in TCDD-treated perch are sufficient to explain mortality. (Author's abstract)
W88-07707

LETHAL TOXICITY OF LINDANE ON A TELEOST FISH, ANGUILLA ANGUILLA FROM ALBUFERA LAKE (SPAIN): HARDNESS AND TEMPERATURE EFFECTS,
Valencia Univ. (Spain). Dept. of Animal Physiology.
M. D. Ferrando, M. M. Almar, and E. Andreu.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 23, No. 1, p 45-52, February 1988. 2 fig, 1 tab, 19 ref.

Descriptors: *Lindane, *Water pollution effects, *Eel, *Hardness effects, *Temperature effects, Toxicity, Fish, Temperature, Water temperature, Lethal limit, Mortality, Insecticides.

The results of Lindane toxicity tests conducted using Anguilla anguilla under three different water temperatures (15, 22 and 29 degrees C) and two hardness regimes (250 and >600 ppm CaCO3) are reported. The 96-h LC sub 50 increased in the experimental medium consisting of dechlorinated drinking water ($p<0.05$) by an order of magnitude from 0.32 to 0.45 mg/L between 15 and 29 degrees C. However, in the natural medium (unfiltered Lake Albufera water) it is similar ($p>0.05$)(0.54 to 0.55 mg/L) for these same temperatures. The toxicity of Lindane on eels increased when the water hardness decreased. The 24, 48, 72, and 96-h LC sub 50 for this fish in both media is less at 15 degrees C (96-h LC50=0.32 and 0.55 mg/L) than at 29 degrees C (96-h LC sub 50=0.45 and 0.55 mg/L). These results suggest that the toxicity of Lindane presents a negative temperature coefficient. (Wood-PTT)
W88-07712

WATER QUALITY AND BIOLOGICAL SURVEY OF THE EASTERN HEADWATER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07723

WATER QUALITY AND BIOLOGICAL SURVEY OF THE LOWER SUSQUEHANNA SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07724

MARINE ECOLOGICAL CONSEQUENCES OF WASTE DISPOSAL,
Office of Technology Assessment, Washington, DC.
N. Sundt.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234118. Price codes: A06 in paper copy, A01 in microfiche. Working Paper, April 27, 1987. 121 p, 14 fig, 6 tab, 1020 ref.

Descriptors: *Waste disposal, *Marine environment, *Water pollution effects, Nutrients, Pathogens, Metals, Organic compounds, Pollutant identification, Wastewater disposal.

The effects of waste disposal activities on marine resources are summarized. The nationwide impacts of pollutants on water quality, sediment quality, and marine organisms are described. A region-by-region summary of the impacts illustrates their broad geographical variations, while providing greater detail on specific problems and water bodies. The precise connection between pollutants and impacts on marine resources often is poorly understood; likewise, the full implications to humans of the marine impacts are not well defined. Given informational shortcomings, a clear and complete picture of the extent of the impacts of waste disposal throughout the country is not available. Despite the problems, however, the available evidence is sufficient to support the following general conclusions: (1) Marine resources have been and will continue to be affected by a wide range of natural and human perturbations, including pollutant discharges; (2) Every region contains some areas which have suffered serious negative impacts from pollutants discharged by waste disposal activities. The most serious impacts from permitted sources appear to result from discharges of nutrients, pathogens, metals, and synthetic organic compounds. Even when present in the water column and sediments in very small quantities, certain metals and synthetic organic chemicals can result in chronic, persistent, and serious effects on organisms; and (3) Where trends in impacts over the last ten to fifteen years are discernable, they have been mixed. They have varied among specific pollutants, species, and locations. In some cases improvements have been observed, in other cases deterioration is evident. Sometimes, no clear trend appears. (Lantz-PTT)
W88-07752

RAIN PROJECT. ANNUAL REPORT FOR 1984,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.

W88-07777

CARCINOGENIC EFFECTS OF ARSENIC COMPOUNDS IN DRINKING WATER,
University of the Pacific, Stockton, CA. School of Pharmacy.
D. Y. Shirachi, S. H. Tu, and J. P. McGowan.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-232542. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/1-87/007, August 1987. 49 p, 8 fig, 29 tab, 18 ref. EPA Contract No. CR-811619.

Descriptors: *Water pollution effects, *Drinking water, *Chromatography, *Carcinogens, *Arsenic, Toxicity, Arsenite, Kidneys, Tissue analysis, Biological studies, Dimethylarsinic acid, Arsenate.

The primary objective of this research project was to determine whether there was a dose-response effect of arsenite (AsIII) as a promoter of DENA-initiated tumors in the kidneys of partially hepatectomized rats. Secondary objectives were to complete the study extending from the previous grant which was to determine whether arsenite (AsIII), arsenate (AsV) and dimethylarsinic acid (DMA) were initiator carcinogens and/or promoters of DENA-initiated tumors in the rat kidney. In addition an analytical method for measuring these three arsenic species simultaneous in the same biological sample was to be developed. A dose-response was observed for AsIII promotion in partially hepatectomized DENA-initiated rats at concentrations of 40, 80 and 160 mg/L in the drinking water but it was not statistically significant. AsIII and AsV did not have any initiator activity in intact male Wistar rats but significantly promoted DENA-initiated renal tumors in these animals. DMA had neither initiator nor promoter activity. A continuous flameless HPLC-electrothermal atomic absorption spectromphotometric method was developed to detect and to quantitate simultaneously nanogram quantities of AsIII, AsV and DMA in biological fluids. (Author's abstract)
W88-07779

INTERIM PROCEDURES FOR PREPARING ENVIRONMENTAL SAMPLES FOR MUTAGENICITY (AMES) TESTING,
S-CUBED, Division of Maxwell Labs., San Diego, CA.
For primary bibliographic entry see Field 5A.
W88-07785

CONCENTRATION TECHNIQUES AIMED AT THE ASSIGNMENT OF ORGANIC PRIORITY POLLUTANTS,
National Inst. of Public Health and Environmental Hygiene, P.O. Box 150, 2260 AD Leidschendam, The Netherlands.
For primary bibliographic entry see Field 5A.
W88-07786

BIOLOGICAL TESTING OF WATERBORNE ORGANIC COMPOUNDS,
Cincinnati Univ., OH. Dept. of Microbiological and Molecular Genetics.
For primary bibliographic entry see Field 5A.
W88-07811

INVESTIGATING THE TOXICOLOGY OF COMPLEX MIXTURES IN DRINKING WATERS,
Environmental Protection Agency, Cincinnati, OH. Toxicology and Microbiology Div.
R. J. Bull.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 751-761, 8 ref.

Descriptors: *Toxicology, *Drinking water, *Water analysis, *Risk assessment, *Water pollution effects, Health effects, Pollutant identification.

Assessment of health hazards associated with drinking water obtained from any source that is potentially contaminated requires knowledge of: (1) the chemicals that are contaminants of that source; (2) the relative concentrations of those contaminants; (3) some objective indication of a potential for producing adverse health effects; and (4) the relationship between the dose of these chemicals and the adverse effects. In general, the more complete this information is, the more confident one can feel about the assessment of risks. The approach of testing a prepared concentrate of a water sample was evaluated versus identifying all the constituents and preparing synthetic mixtures of them. Both approaches have substantial drawbacks. However, critical examination of these methods suggests that they might actually be considered as complementary approaches rather than as alternatives. (See also W88-07783) (Author's abstract)
W88-07819

METHODOLOGY FOR PREDICTING EXPOSURE AND FATE OF PESTICIDES IN AQUATIC ENVIRONMENTS,
Environmental Research Lab., Athens, GA. Office of Research and Development.
For primary bibliographic entry see Field 5B.
W88-07833

HEALTH ASPECTS OF WASTE-WATER REUSE FOR IRRIGATION OF CROPS,
Pan American Health Organization (PAHO), Washington, DC. Environmental Health Program.
For primary bibliographic entry see Field 3C.
W88-07865

CASE STUDY FOR CONTROL OF BORON POLLUTION,
State Planning Organization, Sectoral Programming Dept., Ankara (Turkey).
H. S. Cengiz.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 314-316.

Descriptors: *Turkey, *Boron, *Mine drainage, *Water pollution prevention, *Wastewater disposal, *Water pollution sources, *Water pollution effects, *Irrigation water, Case studies, Water pollution control, Soil contamination, Wastewater management, Storage reservoirs, Dams, Ocean dumping, Pipelines.

A case study was made to examine alternatives to prevent irrigated areas in northwest Turkey from being polluted with boron from irrigation water obtained from the Simav River. The river receives mine drainage from the Bigadic Borax Mines. Irrigation waters also contaminate the soils of the Balikesir and Susurluk plains making them unsuitable for growing crops due to high boron concentrations. Three alternatives have been identified to prevent adverse effects on crops from the boron polluted irrigation water. The first involves discharging boron polluted water to the sea by a pipeline. The second alternative would be to discharge boron polluted water to the sea by a canal. The third alternative involves constructing a dam for storing the polluted water during the irrigation period, then discharging it to the Simav River after the irrigation season is over. The construction of the Ayitlidere dam seems to be the least costly of the three alternatives in the planning stage. (See also W88-07850) (Geiger-PTT)
W88-07869

LAND APPLICATION OF SLUDGE: FOOD CHAIN IMPLICATIONS.
For primary bibliographic entry see Field 5E.
W88-07904

EFFECTS OF LONG-TERM SLUDGE APPLICATION ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-07907

TRANSFER OF SLUDGE-APPLIED TRACE ELEMENTS TO THE FOOD CHAIN,
For primary bibliographic entry see Field 5B.
W88-07908

EFFECTS OF TRACE ORGANICS IN SEWAGE SLUDGES ON SOIL-PLANT SYSTEMS AND ASSESSING THEIR RISK TO HUMANS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
L. W. Jacobs, G. A. O'Connor, M. A. Overcash, M. J. Zabik, and P. Rygiewicz.
IN: Land Application of Sludge: Food Chain Implications. Lewis Publishers, Inc., Chelsea, Michigan. 1987. p 101-143, 16 tab, 115 ref.

Descriptors: *Organic compounds, *Sludge disposal, *Land disposal, *Path of pollutants, *Toxicity, *Risk assessments, *Public health, Mutagens, Water pollution effects, Leaching, Adsorption, Public health, Soil contamination, Volatility, Degradation, Pesticides, Mathematical models, Risks, Crop production, Bioaccumulation.

Because sewage sludges can theoretically contain thousands of organic compounds, wastewater treatment plants should identify the organics being discharged by users, particularly industry. Available surveys measuring trace organic concentrations in sludges indicate that sewage sludges can have unusually high concentrations. Most organics, however, are present at concentrations <10 mg/kg, and about 30% of the organics tested were below detection limits. Based on their prevalence and potential loading to soils using agronomic or low sludge rates, sludge organics appear to present minimal risk. Mutagenicity tests have been used to evaluate the safety of sewage sludges for land application. While such tests might provide an additional means of checking sewage sludges prior to land application, they are difficult to interpret and have not been correlated to mutagenic activity or biological toxicity of soil/sludge mixtures in the field. Major assimilative pathways for organic chemicals applied to the soil-plant system include adsorption, volatilization, degradation, leaching, and plant uptake. Due to the large number of organics which can be present in sewage sludges, mathematical models that utilize basic physical/chemical properties of an organic to predict the fate of sludge organics in soil appear to be a logical approach. Field research is needed to validate the accuracy of these models. Risk assessments suggest that most sludge organics will not increase the health risk to animals, and humans, based on their relative toxicities and anticipated loadings to soil from agronomic or low sludge application rates. Better methodologies are needed to more completely assess health risks. (See also W88-07904) (Author's abstract)
W88-07909

ALUMINUM CHEMISTRY: FRACTIONATION, SPECIATION, AND MINERAL EQUILIBRIA OF SOIL INTERSTITIAL WATERS OF AN ALPINE WATERSHED, FRONT RANGE, COLORADO,
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.
For primary bibliographic entry see Field 5B.
W88-07928

RISK ASSESSMENT OF SOIL CONTAMINATION CRITERIA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
C. M. King, W. L. Marter, D. F. Montaque, and G. A. Holton.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011179. Price codes: A02 in paper copy, A01 in microfiche. 1987. 24 p, 3 fig, 7 tab, 13 ref. Contract No. DE-AC09-76SR00001.

Descriptors: *Contamination, *Soil contamination, *Soil pollution effects, *Radioactive wastes, *Risks, Remedies, Public health, Wastewater treatment facilities, Population exposure, Carcinogens, Toxins, Groundwater pollution.

Waste sites at U.S. Department of Energy facilities often contain many radioactive and nonradioactive contaminants. Remedial actions for these sites are being determined, in part, by the risk the contamination poses to the public. However, it is impractical to analyze every contaminant present. This study attempted to develop a way to screen unimportant risk contributors in order to focus resources on the principal contributors to risk. To determine which constituents should be analyzed at waste sites at the Savannah River Plant, Savannah River Laboratory (SRL) analyzed data from waste site soil characterization studies, groundwater analyses, and influent levels, and the concentration of each chemical was compared to a selection criterion developed by SRL. Selection criteria were based on toxicological and modeling information provided by the U.S. Environmental Protection Agency (EPA) that included grounwater concentration guidelines and soil concentration guidelines. To determine if the criteria were appropriate for screening out unimportant risk contributors, a risk assessment was perfomed using a hypothetical 'Benchmark Site,' which contains both radioactive and nonradioactive contaminants at levels equal to the criteria values. In this analysis, if the upper bound of risk posed by the Benchmark Site on the public is acceptable, then it follows that the risk posed to the public due to unselected contaminants at each site is also acceptable. Public exposures and risk were estimated for both carcinogens and noncarcinogens. Twenty-four one-year assessments were performed to span a one-thousand-year period. It was found that health risks to the public from atmospheric releases of radioactive and nonradioactive materials from a waste site at soil criteria contamination levels are low. Based on this study's atomospheric exposure pathways analysis and risk assessment, the applied soil criteria are appropriate for screening out unimportant risk contributors to human health from atmospheric exposure pathways. (Friedmann-PTT)
W88-07957

5D. Waste Treatment Processes

CITRUS PROCESSING WASTEWATER TREATMENT,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
S. Hawash, A. J. Hafez, and G. El-Diwani.
Chemieingenieurtechnik CITEAH, Vol. 60, No. 2, p 128-130, February 1988. 2 fig, 1 tab, 7 ref.

Descriptors: *Citrus fruits, *Process water, *Canneries, *Food-processing wastes, *Wastewater treatment, *Activated sludge process, *Ozonation, Chemical oxygen demand, Egypt, Economic evaluation.

Characteristics of effluents from 'Kaha Food Industry' in the citrus season are summarized, together with the maximum allowable values determined by Governmental Rule for waste effluents in water streams/material/law 48/year 1982 by the Egyptian Ministry of Irrigation. Canneries waste treatment disposal methods are outlined. From a previous experimental study, a convenient process was developed to provide safe wastewater for Egyptian waste streams. The process utilizes biological treatment to decompose organic matter and decreases the COD to a value of 230 ppm, using 16 L of air per L of treated wastewater for a contact time of 2.5 h. Ozone is used subsequently for further purification of the wastewater by destroying refractory organics. Based on a rate of wastewater effluents per day of 600 cu m at Kaha Food Industry and on preliminary bench scale results, a recommended process for treatment is shown, and an economic evaluation has been performed. (Author's abstract)
W88-06824

UTILIZATION OF SURFACE WATER FOR DRINKING PURPOSES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Biology.
For primary bibliographic entry see Field 5F.
W88-06829

FILTER OF THE WATER SUPPLY OF THE CITY OF LAWRENCE, AND ITS RESULTS,
For primary bibliographic entry see Field 5F.
W88-06831

REMOVAL OF TRACE LEVELS OF PHENOLS FROM AQUEOUS SOLUTION BY FOAM FLOTATION,
Dept. of Science and Mathematics, Trevecca Nazarene College, Nashville, TN 37203.
G. A. Nyssen, G. S. Lovell, A. A. Simon, J. G. Smith, and B. K. Tolar.
Separation Science and Technology SSTEDS, Vol. 22, No. 11, p 2127-2141, November 1987. 11 fig, 1 tab, 10 ref.

Descriptors: *Wastewater treatment, *Trace levels, *Phenols, *Surfactants, *Cations, *Flotation, *Foam separation, *Pentachlorophenol, Hydrogen ion concentration, Alcohols.

Pentachlorophenol (PCP) was removed from water by foam flotation with the cationic surfactant cetyltrimethylammonium bromide (CTAB). With initial PCP concentrations of 20 ppm or less, residual PCP concentrations of less than 0.05 ppm were obtained after 5 min flotation. The CTAB concentration and flotation time are directly related to the amount of PCP removed. PCP removal is most efficient at neutral to basic pH and at low ionic strength. PCP removal is less effective with sodium dodecyl sulfate. As much as 80% of the CTAB can be replaced by dodecylamine without inhibiting PCP removal. Alcohols up to 10% by volume do not affect PCP removal. Other phenols can also be removed equally well by foam flotation if the phenol is in the anionic form during flotation. (Author's abstract)
W88-06839

ENRICHMENT OF ARSENIC AND ITS SEPARATION FROM OTHER ELEMENTS BY LIQUID-PHASE POLYMER-BASED RETENTION,
Vernadsky Inst. of Geochemistry and Analytical Chem., Acad. of Sciences, Moscow 117975, USSR.
For primary bibliographic entry see Field 5A.
W88-06840

REVOLUTION IN WASTEWATER TREATMENT,
NASA, NSTL, Building 2423, NSTL, MS 39529.
B. Gillette.
Biocycle BCYCDK, Vol. 29, No. 3, p 48, 50-51, March 1988. 1 fig.

Descriptors: *Wetlands, *Artificial wetlands, *Wastewater treatment, *Municipal wastewater, *Marshes, *Economic efficiency, *Design criteria, *Aquatic plants, Bulrushes, Duckweed, Water hyacinths, Ornamentals, Seasonal variation.

Collins, MS, San Diego, CA, Monterey, VA, and Haughton, LA are just a few of the many cities in the U.S. that are joining a quiet revolution in wastewater treatment. Plants are being used as a key element in artificial marshland wastewater treatment systems that take advantage of natural processes to make a significant difference in the purity of wastewater effluent. In most cases, the natural systems work better and are less expensive to build, operate and maintain than the mechanical systems replaced. Some of the aquatic plants that have been studied for use in wastewater treatment are hyacinths, duckweed, bulrush and several ornamental plants. Artificial marsh design, and the effectiveness of the system in winter is also discussed. (VerNooy-PTT)
W88-06842

SLUDGE INCREASES PULPWOOD PRODUCTION,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5E.
W88-06843

ALGAL POPULATION AND AUXOTROPHIC ADAPTATION IN A SUGAR REFINERY WASTEWATER ENVIRONMENT,
Unidad de Biologia General, Dept. de Biologia, Facultad de Ciencias, Universidad Autonoma de Madrid, Cantoblanco, Madrid-28049, Spain.
F. Martinez, M. D. C. Avendano, E. Marco, and M. I. Orus.
Journal General and Applied Microbiology JGAMA9, Vol. 33, No. 4, p 331-341, August 1987. 2 fig, 4 tab, 32 ref.

Descriptors: *Algae, *Chlorella, *Heterotrophs, *Scenedesmus, *Industrial wastewater, *Wastewater treatment, *Adaptation, *Glucose, Sugars, Chlorophyta, Species composition, Isolation, Axenic culture, Growth, Kinetics.

This study was conducted with algae living in a sugar refinery wastewater environment. Algae common in organic-polluted environments such as Chlorella sp., and Scenedesmus quadricauda were found, along with some other species not so common in this type of environment. Most species were isolated and the resulting axenic cultures were used to establish their heterotrophic potential with different organic compounds found in this type of habitat. Chlorella sp., showed the best adaptive pattern since it had adapted its glucose transport system to operate by facilitated diffusion. It exhibited a higher affinity than other systems of glucose facilitated diffusion and also a higher V sub m, which was obtained at about the sugar concentration occurring in its natural habitat. Moreover, Chlorella sp., could increase its glucose uptake rate under some specific conditions of growth. (Author's abstract)
W88-06845

TREATMENT OF LEACHATE FROM A SOLID WASTE LANDFILL SITE USING A TWO-STAGE ANAEROBIC FILTER,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
Y. C. Wu, O. J. Hao, K. C. Ou, and R. J. Scholze.
Biotechnology and Bioengineering BILED3, Vol. 31, No. 3, p 257-266, February 1988. 7 fig, 3 tab, 41 ref. Army Construction Engineering Res. Lab., Champaign, IL, Grant No. DACA 888 EC 0013.

Descriptors: *Biofiltration, *Wastewater treatment, *Solid wastes, *Leachates, *Landfills, *Anaerobic digestion, *Digested sludge, *Organic matter, *Volatile acids, *Process control, Multiphase flow, Iron, Zinc, Biological oxygen demand, Chemical oxygen demand.

Raw leachate was treated using a two-stage upflow anaerobic filter process. Leachate from a solid waste landfill site, which received both municipal and industrial wastes, contained high organic matter (17-21 g/L COD, 13-14 g/L BOD, and 3.5-4.6 g/L volatile acids), and low metal (Zn and Fe) concentrations. Depending on sampling time, leachate composition and characteristics varied considerably. At an organic loading up to 4 g COD/sq day media area, the BOD and COD removal percentages were 98 and 91%, respectively. The biofilters were also effective for metal removal. However, the filter effluent contained a high concentration of ammonia. System overloading was characterized by the accumulation of large quantities of volatile acids and by a low ratio of alkalinity/volatile acids, resulting in low COD removal and reduced gas production. Once the first filter was upset, the second stage could only partially respond to the volatile acids accumulated in the effluent of first filter. (Author's abstract)
W88-06850

KINETICS OF MICROBIAL GROWTH ON MIXTURES OF PENTACHLOROPHENOL AND CHLORINATED AROMATIC COMPOUNDS,
Environmental Chemistry Res. Laboratory, Dow Chemical U.S.A., 1701 Building, Midland, MI 48674.
G. M. Kelcka, and W. J. Maier.
Biotechnology and Bioengineering BILED3, Vol. 31, No. 4, p 328-335, March 1988. 6 fig, 2 tab, 28 ref.

Descriptors: *Wastewater treatment, *Growth kinetics, *Bacteria, *Microbial degradation, *Phenols, *Pentachlorophenol, *Chlorinated hydrocarbons, *Aromatic compounds, *Organic carbon, *Mathematical models, *Carbon sources, Optimization, Simulation analysis.

Batch experiments were conducted to examine the effects of several substrate analogs on the degradation of pentachlorophenol by an enrichment culture of pentachlorophenol-utilizing bacteria. The presence of substrate analogs which were unable to serve as a carbon source for growth of the culture (e.g., 3,5,6-trichloro-2-pyridinol, 2,4-dichlorophenoxyacetic acid) decreased the rate of pentachlorophenol degradation. The presence of a utilizable substrate analog (e.g., phenol, 2,4,5-trichlorophenol) also inhibited the initial rate of pentachlorophenol degradation; however, the overall removal rate was accelerated due to an increase in cell mass concentration as a result of simultaneous growth on both substrates. These effects were shown to be predicted by a mathematical model based on a modified Monod equation. Kinetic parameters obtained from the results of laboratory studies can be used for further process analysis to define the optimal conditions for the biological treatment of complex mixtures of phenolic compounds. (Author's abstract)
W88-06851

SODIUM INHIBITION OF ACETOCLASTIC METHANOGENS IN GRANULAR SLUDGE FROM A UASB REACTOR,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. Rinzema, J. van Lier, and G. Lettinga.
Enzyme and Microbial Technology EMTED2, Vol. 10, No. 1, p 24-32, January 1988. 6 fig, 4 tab, 50 ref. Dutch Government, Clean Technology Program Grant (F.41)LH511.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Sludge digestion, *Methane bacteria, Sodium, Toxicity, Inhibition, Inhibitors, Hydrogen ion concentration, Digestion, Biological wastewater treatment.

The effect of sodium on the formation of methane from acetate in granular sludge from an Upflow Anaerobic Sludge Bed (UASB) reactor was determined at various acetate concentrations and pH-levels. At neutral pH, sodium concentrations of 5, 10 and 14 g Na(+)/liter caused 10, 50, and 100% inhibition, respectively, relative to the maximum specific acetoclastic methanogenic activity of the granular sludge. These values reflect the sensitivity of Methanothrix sp, towards sodium, as this is the predominant acetoclastic methanogen in the granular sludge used. The pH did not affect the inhibitory action of sodium significantly in the range of 6.5-7.2, but at pH-levels near 8, the inhibition was more pronounced. At acetate concentrations below 500 milligrams/liter, diffusion limitation partly masked the influence of sodium on the specific activity of the granulated sludge. No adaptation of Methanothrix sp. to high sodium concentrations could be obtained in a period of 12 weeks. Net growth of Methanothrix sp. could be obtained at sodium concentrations of approximately 10 g/liter. At equal sodium concentrations, sodium chloride had a somewhat stronger effect on the specific activity than sodium sulfate, but the difference in unimportant for design purposes. The results obtained with short-term activity measurements can reliably be used for predictions of the effect of sodium salts on continuously fed UASB reactors. (Author's abstract)
W88-06869

REMOVAL OF FLOODWATER NITROGEN IN A CYPRESS SWAMP RECEIVING PRIMARY WASTEWATER EFFLUENT,
Central Florida Research and Education Center, Sanford, FL.
W. F. DeBusk, and K. R. Reddy.
Hydrobiologia HYDRB8, Vol. 153, No. 1, p 79-86, October 9, 1987. 4 fig, 2 tab, 22 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Swamps, *Nitrogen removal, *Wastewater disposal, Wetlands, Ammonia, Nitrification, Denitrification, Sediments, Nitrates, Sediment-water interfaces.

Intact sediment-water columns from a flowing cypress swamp receiving primary wastewater effluent were used to evaluate inorganic nitrogen removal and to determine the fate of N15-labeled ammonium ion added to the floodwater. Treatments represented wetland sites which had received zero (initial application) 2, and 50 years of primary wastewater application. The rate of inorganic-N decrease in the floodwater was greatest for the initial application columns, primarily due to sediment adsorption of ammonium ion, followed by 2-year and 50-year columns. Maximum removal rates were 318, 296, and 148 mg N/sq m/day, respectively. At the end of the 21-day study period, only 0.5 to 2.3% of applied N15 was recovered in the floodwater and 11.4 to 17.3% was recovered in the sediment, with the remaining 82.2 to 86.3% being lost from the sediment-water system. Results of the study indicate that N removal efficiency did not decrease with prolonged wastewater application, despite reduced sediment adsorption capacity, because of the significance of gaseous N losses (nitrification-denitrification, ammonia volatilization) as an N sink in the sediment-water system. (Author's abstract)
W88-06894

ACCUMULATION, DEGRADATION AND BIOLOGICAL EFFECTS OF LINDANE ON SCENEDESMUS OBLIQUUS (TURP.) KUTZ,
Research Institute of Environmental Chemistry, Academic Sinica, Beijing, China.
L. Yi-xiong, and S. Bo-zen.
Hydrobiologia HYDRB8, Vol. 153, No. 3, p 249-252, October 30, 1987. 3 fig, 3 tab, 6 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Industrial wastewater, *Pesticides, *Lindane, *Algae, *Degradation, *Biodegradation, Insecticides, Reservoirs, China.

Samples of Scenedesmus obliquus were exposed to lindane solutions (0, 0.1, 1, 10, 50, and 100 mg/liter) to assess the feasibility of using the algae in treatment of pesticide-containing industrial wastewaters discharged into a sewage reservoir in China. At lindane concentrations of 50-100 mg/liter algal growth was inhibited, and chlorophyll and carotene content was decreased. At the lower lindane concentrations (1-10 mg/liter) algal growth, chlorophyll content, and carotene content did not differ much from the control; amino acids composition remained constant but below that of the control, especially aspartine, arginine, methionine, and phenylalanine. This indicated a toxic reaction. The degree of lindane accumulation by S. obliquus was greater at the 1 mg/liter concentration than at 10 mg/liter and was enhanced by turbulence and time. For example, lindane at 1 mg/liter was reduced to 0.423 mg/liter after 15 min exposure to algae without stirring and to 0.322 mg/liter at 360 min. Lindane accumulations in the algae at the same starting concentration and without stirring were 70.9 microgram/liter after 15 min and 164.5 microgram/liter after 360 min. Lindane degradation also occurred in the algae as shown by chromatographic peaks. (Cassar-PTT)
W88-06899

BIODEGRADATION DATA EVALUATION FOR STRUCTURE/BIODEGRADABILITY RELATIONS,
Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.
For primary bibliographic entry see Field 5B.
W88-06921

PREDICTION OF CONSUMER PRODUCT CHEMICAL CONCENTRATIONS AS A FUNCTION OF PUBLICLY OWNED TREATMENT WORKS TREATMENT TYPE AND RIVERINE DILUTION,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
For primary bibliographic entry see Field 5B.
W88-06954

CONTROL OF INTERSPECIES ELECTRON FLOW DURING ANAEROBIC DIGESTION: ROLE OF FLOC FORMATION IN SYNTROPHIC METHANOGENESIS,
Michigan Biotechnology Inst., P.O.Box 27609, Lansing, Michigan 48909.
J. H. Thiele, M. Chartrain, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 10-19, January 1988. 6 fig, 2 tab, 32 ref.

Descriptors: *Biological wastewater treatment, *Anaerobic bacteria, *Anaerobic digestion, *Wastewater treatment, *Flocculation, *Microbiological studies, Anaerobic conditions, Food-processing wastes, Bacteria.

The flora of an anaerobic whey-processing chemostat was separated by anaerobic sedimentation techniques into a free-living bacterial fraction and a bacterial floc fraction. The floc fraction constituted a major part (i.e., 57% total protein) of the total microbial population in the digester, and it accounted for 87% of the total CO2-dependent methanogenic activity and 76% of the total ethanol-consuming acetogenic activity. Lactose was degraded by both cellular fractions, but in the free flora fraction it was associated with higher intermediary levels of H2, ethanol, butyrate, and propionate production. Electron microscopic analysis of flocs showed bacterial diversity and juxtapositioning of tentative Desulfovibrio and Methanobacterium species without significant microcolony formation. Ethanol, an intermediary product of lactose-hydrolyzing bacteria, was converted to acetate and methane within the flocs by interspecies electron transfer. Ethanol-dependent methane formation was compartmentalized and closely coupled kinetically within the flocs but without significant formation of H2 gas. Physical disruption of flocs into fragments of 10- to 20-micron diameter initially increased the H2 partial pressure but did not change the carbon transformation kinetic patterns of ethanol metabolism or demonstrate a significant role for H2 in CO2 reduction to methane. The data demonstrate that floc formation in a whey-processing anaerobic digester functions in juxtapositioning cells for interspecies electron transfer during syntrophic ethanol conversion into acetate and methane but by a mechanism which was independent of the available dissolved H2 gas pool in the ecosystem. (See also W88-06998) (Author's abstract)
W88-06997

CONTROL OF INTERSPECIES ELECTRON FLOW DURING ANAEROBIC DIGESTION: SIGNIFICANCE OF FORMATE TRANSFER VERSUS HYDROGEN TRANSFER DURING SYNTROPHIC METHANOGENESIS IN FLOCS,
Michigan Biotechnology Inst., P.O.Box 27609, Lansing, Michigan 48909.
J. H. Thiele, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 20-29, January 1988. 9 fig, 2 tab, 40 ref.

Descriptors: *Model studies, *Biological wastewater treatment, *Anaerobic bacteria, *Anaerobic digestion, *Wastewater treatment, *Flocculation, *Microbiological studies, Anaerobic conditions, Bacteria, Food-processing wastes.

Microbial formate production and consumption during syntrophic conversion of ethanol or lactate to methane was examined in purified flocs and digester contents obtained from a whey-processing digester. Formate production by digester contents or purified digester flocs was dependent on CO2 and either ethanol or lactate but not H2 gas as an electron donor. During syntrophic methanogenesis, flocs were the primary site for formate production via ethanol-dependent CO2 reduction, with a formate production rate and methanogenic turnover constant of 660 micro-moles/h and 0.044/min, respectively. Floc preparations accumulated four-fold-higher levels of formate (40 micro-moles) than digester contents, and the free flora was the primary site for formate cleavage to CO2 and H2 (90 micro-moles formate per h). Inhibition of methano-

genesis by CHCl3 resulted in formate accumulation and suppression of syntrophic ethanol oxidation. H2 gas was an insignificant intermediary metabolic of syntrophic ethanol conversion by flocs, and its exogenous addition neither stimulated methanogenesis nor inhibited the initial rate of ethanol oxidation. These results demonstrated that >90% of the syntrophic ethanol conversion to methane by mixed cultures containing primarily Desulfovibrio vulgaris and Methanobacterium formicicum was mediated via interspecies formate transfer and that <10% was mediated via interspecies H2 transfer. The results are discussed in relation to biochemical thermodynamics. A model describes the dynamics of a bicarbonate-formate electron shuttle mechanism for control of carbon and electron flow during syntrophic methanogenesis and provides a mechanism for energy conservation by syntrophic acetogens. (See also W88-06997) (Author's abstract)
W88-06998

ENVIRONMENTAL FACTORS AFFECTING INDOLE METABOLISM UNDER ANAEROBIC CONDITIONS,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
E. L. Madsen, A. J. Francis, and J.-M. Bollag.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 1, p 74-78, January 1988. 5 fig, 25 ref. DOE Grant DE-FG02-87ER60556.

Descriptors: *Sludge digestion, *Denitrification, *Methane bacteria, *Indoles, *Anaerobic bacteria, *Anaerobic digestion, *Wastewater treatment, *Flocculation, Microbiological studies, Metabolites, Anaerobic conditions, Culturing techniques, Incubation, Bacteria.

The influence of physiological and environmental factors on the accumulation of oxindole during anaerobic indole metabolism was investigated by high-performance liquid chromatography. Under methanogenic conditions, indole was temporarily converted to oxindole in stoichiometric amounts in media inoculated with three freshwater sediments and an organic soil. In media inoculated with methanogenic sewage sludge, the modest amounts of oxindole detected at 35 deg C reached higher concentrations and persisted longer when the incubation temperature was decreased from 35 to 15 deg C. Also, decreasing the concentration of sewage sludge used as an inoculum from 50 to 1% caused an increase in the accumulation of oxindole from 10 to 75% of the indole added. Under denitrifying conditions, regardless of the concentration or source of the inoculum, oxindole appeared in trace amounts but did not accumulate during indole metabolism. In addition, denitrifying consortia which previously metabolized indole degraded oxindole with no lag period. The data suggest that oxindole accumulation under methanogenic, but not under denitrifying conditions, is caused by differences between relative rates of oxindole production and destruction. (Author's abstract)
W88-06999

ASSESSMENT OF RECOVERY EFFICIENCY OF BEEF EXTRACT REAGENTS FOR CONCENTRATING VIRUSES FROM MUNICIPAL WASTEWATER SLUDGE SOLIDS BY THE ORGANIC FLOCCULATION PROCEDURE,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
R. S. Safferman, M. E. Rohr, and T. Goyke.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 309-316, February 1988. 2 fig, 7 tab, 17 ref.

Descriptors: *Domestic wastes, *Sludge solids, *Wastewater treatment, *Organic flocculation, *Viruses, Comparison studies, Beef extract, Performance evaluation, Biological wastewater treatment, Wastewater.

The capacity of beef extract reagents to form flocs suitable for virus adsorption was assessed. Reagent comparisons resulted in the establishment of a modified organic flocculation procedure to concentrate viruses desorbed from sewage sludge solids with currently available modified powdered beef extracts. The method, based on supplementation with paste beef extract floc, achieved virus recoveries comparable to those obtained with powdered beef extract produced before a 1979 change in the manufacturing process. When primary settled sludge solids originating from mostly domestic waste were eluted with an unsupplemented modified powered beef extract, high virus recovery efficiency was observed upon concentration by organic flocculation. This appreciable increase might have been due to floc-forming substances that were present in the primary settled sludge. These substances did not appear to be present in settled sludge collected from biologically treated wastes. Apparently, the floc-forming substances had been either removed or substantially altered during biological treatment.(Author's abstract)
W88-07004

REDUCTIVE DECHLORINATION OF HEXACHLOROBENZENE TO TRI- AND DICHLOROBENZENES IN ANAEROBIC SEWAGE SLUDGE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
B. Z. Fathepure, J. M. Tiedje, and S. A. Boyd.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 327-330, February 1988. 4 fig, 19 ref. U.S. Air Force Grant FO8635-83-C-00290.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Anaerobic digestion, *Dechlorination, *Biodegradation, *Hexachlorobenzenes, Aromatic compounds, Organic compounds, Polychlorinated biphenyls, Biological wastewater treatment, Wastewater.

Hexachlorobenzene was dechlorinated to tri- and dichlorobenzenes in anaerobic sewage sludge. The complete biotransformation of 190 micromoles hexachlorobenzene (50 ppm) occurred within 3 weeks. The calculated rate of hexachlorobenzene dechlorination was 13.6 micromol/L/day. Hexachlorobenzene was dechlorinated via two routes, both involving the sequential removal of chlorine from the aromatic ring. The major route was hexachlorobenzene to pentachlorobenzene to 1,2,3,5-tetrachlorobenzene to 1,3,5-trichlorobenzene. Greater than 90% of the added hexachlorobenzene was recovered as 1,3,5-trichlorobenzene, and there was no evidence for further dechlorination of 1,3,5-trichlorobenzene. The minor route was hexachlorobenzene to pentachlorobenzene to 1,2,4,5-tetrachlorobenzene to 1,2,4-trichlorobenzene to dichlorobenzenes. These results extend reductive dechlorination to poorly water soluble aromatic hydrocarbons which could potentially include other important environmental pollutants like polychlorinated biphenyls. (Author's abstract)
W88-07005

REDUCTIVE CARBOXYLATION OF PROPIONATE TO BUTYRATE IN METHANOGENIC ECOSYSTEMS,
Station de Technologie Alimentaire, Institut National de la Recherche Agronomique, 59 rue Jules Guesde, B.P. 39, 59651.
J. L. Tholozan, E. Samain, J. P. Grivet, R. Moletta, and H. C. Dubourguier.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 441-445, February 1988. 4 fig, 2 tab, 21 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, *Acetogenesis, *Biodegradation, *Propionates, *Butyrates, Carbon radioisotopes, Metabolites, Isotope studies, Organic compounds, Wastewater.

During the batch degradation of sodium propionate by the anaerobic sludge from an industrial digester, a significant amount of butyrate formation was observed. Varying the initial propionate concentrations did not alter the ratio of maximal butyrate accumulation to initial propionate concentration within a large range. By measuring the decrease in the radioactivity of (1-14C)butyrate during propionate degradation, it was estimated that about 20% of the propionate was converted to butyrate. Labeled butyrate was formed from (1-14C)propionate with the same specific radioactivity, suggesting a possible direct pathway from propionate to butyrate. This hypothesis was confirmed by nuclear magnetic resonance studies with (13C)propionate. The results showed that (1-13C)-, (2-13C)-, and (3-13C)propionate were converted to (2-13C)-, (3-13C)-, and (4-13C)butyrate, respectively, demonstrating the direct carboxylation on the carboxyl group of propionate without randomization of the other two carbons. In addition, an exchange reaction between C-2 and C-3 of the propionate was observed, indicating that acetogenesis may proceed through a randomizing pathway. The physiological significance and importance of various metabolic pathways involved in propionate degradation are discussed, and an unusual pathway of butyrate synthesis is proposed. (Author's abstract)
W88-07010

INACTIVATION OF PARTICLE-ASSOCIATED COLIFORMS BY CHLORINE AND MONOCHLORAMINE,
Environmental Protection Agency, Cincinnati, OH.
D. Berman, E. W. Rice, and J. C. Hoff.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 507-512, February 1988. 2 fig, 5 tab, 12 ref.

Descriptors: *Inactivation, *Wastewater treatment, *Disinfection, *Primary wastewater treatment, *Coliforms, *Chlorine, *Monochloramine, Effluents, Wastewater, Disinfection.

Sieves and nylon screens were used to separate primary sewage effluent solids into particle fractions of <7- or >7-micron size. The efficiency of separation was determined by using a particle counter. Indigenous coliforms associated with the particle fractions were tested for their resistance to chlorine and monochloramine. Coliforms associated with the <7-micron fraction were inactivated more rapidly by 0.5 mg of chlorine per liter at 5 deg C and pH 7 than coliforms associated with the >7-micron fraction. Homogenization of the >7-micron fraction not only resulted in an increase in the number of <7-micron particles, but also increased the rate of inactivation to a rate similar to that of the <7-micron fraction. With 1 mg of monochloramine per liter at 5 deg C and pH 7, particle size had no appreciable effect on the rate of inactivation. At pH 8, however, the <7-micron fraction was inactivated more rapidly than the >7-micron fraction. The time required for 99% inactivation of the particle fractions with monochloramine at pH 7 or 8 was 20- to 50-fold greater than the time required for the same amount of inactivation with chlorine at pH 7. The results indicate that coliforms associated with sewage effluent particles are inactivated more rapidly with 0.5 mg of chlorine per liter than with 1.0 mg of monochloramine per liter. However, >7-micron particles can have a protective effect against the disinfecting action of chlorine. (Author's abstract)
W88-07012

TRANSFER AND EXPRESSION OF MESOPHILIC PLASMID-MEDIATED DEGRADATIVE CAPACITY IN A PSYCHROTROPHIC BACTERIUM,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5G.
W88-07017

DIRECT CHARACTERIZATION OF METHANOGENS IN TWO HIGH-RATE ANAEROBIC BIOLOGICAL REACTORS,
BP America, Cleveland, Ohio 44128, and Wadsworth Center for Laboratories and Research, New York State.
H. A. Kobayashi, E. C. de Macario, R. S. Williams, and A. J. L. Macario.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 693-698, March 1988. 4 fig, 2 tab, 20 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Biological wastewater treatment, *An-

alytical methods, *Species composition, *Methanogens, Turbulence, Microbiological studies, Microorganisms, Electron microscopy.

The methanogenic flora from two types of turbulent, high-rate reactors was studied by immunologic methods as well as by phase-contrast, fluorescence, and scanning electron microscopy. The reactors were a fluidized sand-bed biofilm ANITRON reactor and an ultrafiltration membrane-associated suspended growth MARS reactor (both trademarks of Air Products and Chemicals, Inc., Allentown, Pa.). Conventional microscopic methods revealed complex mixtures of microbes of a range of sizes and shapes, among which morphotypes resembling Methanothrix spp. and Methanosarcina spp. were noticed. Precise identification of these and other methanogens was accomplished by antigenic fingerprinting with a comprehensive panel of calibrated antibody probes of predefined specificity spectra. The methanogens identified showed morphotypes and antigenic fingerprints indicating their close similarity with the following reference organisms: Methanobacterium formicicum MF and Methanosarcina barkeri W in the ANITRON reactor only: Methanosarcina barkeri R1M3, M. mazei S6, Methanogenium cariaci JR1, and Methanobrvibacter arboriphilus AZ in the MARS reactor only; and Methanobrevibacter smithii ALI and Methanothrix soehngenii Opfikon in both reactors. Species diversity and distribution appeared to be, at least in part, dependent on the degree of turbulence inside the reactor. (Author's abstract)
W88-07020

APPLICATION OF THE FLUORESCENT-ANTIBODY TECHNIQUE FOR THE DETECTION OF SPHAEROTILUS NATANS IN ACTIVATED SLUDGE,
Pretoria Univ. (South Africa). Dept. of Microbiology and Plant Pathology.
A. R. Howgrave-Graham, and P. L. Steyn.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 799-802, March 1988. 2 fig, 2 tab, 12 ref.

Descriptors: *Fluorescent antibody technique, *Bulking sludge, *Analytical methods, *Wastewater analysis, *Wastewater treatment, *Sphaerotilus, *Activated sludge, *Microbiological studies, Microorganisms, Bacterial physiology, Bacteria.

Sphaerotilus natans, one of the most widely reported causes of bulking in activated sludge, can exist both within and outside of a sheath. It can easily be confused with similar activated sludge bacteria and thus can be overlooked when present in low numbers. Fluorescent antiserum was successfully prepared against the nonfilamentous form and was shown to be highly specific, showing no reaction with either pure cultures of similar filamentous bacteria or entirely unrelated organisms. It did, however, show a lack of strain specificity since it reacted with S. natans isolates from the Federal Republic of Germany and the United States and with filamentous bacteria in South African activated sludges. Fluorescent antibody is capable of penetrating the filaments of S. natans to stain the cells individually. The use of fluorescent antiserum in the identification of S. natans filaments obscured by activated sludge flocs and other suspended matter was simple because the cells stained brightly could be observed through the less dense matter, while the use of other microscope techniques would be hampered by these obstructions. The use of fluorescent antibody will facilitate ecological studies of S. natans in activated sludge and other aqueous environments. (Author's abstract)
W88-07025

LOW-TEMPERATURE STABILITY OF VIRUSES IN SLUDGES,
Dept. of Civil and Environmental Engineering, Univ. of Cincinnati, Cincinnati, Ohio 45221.
G. Berg, G. Sullivan, and A. D. Venosa.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 839-841, March 1988. 2 fig, 1 tab, 9 ref. EPA Contract 68-03-3183.

Descriptors: *Sludge, *Viruses, *Wastewater treatment, *Enteroviruses, *Hydrogen ion concentration, *Temperature effects, *Wastewater analysis, Viruses, Microbiological studies, Microorganisms, Survival.

Enteroviruses survived for up to 38 days without diminishing in numbers in extended-aeration sludges maintained at 5 deg C. In oxidation ditch sludges similarly maintained, enteroviruses survived for up to 17 days without diminishing in numbers. The pHs of the sludges were well inside the pH 6 to 8 corridor in which destruction of enteroviruses by the detergents and ammonia present in sludges reportedly does not occur. Unexplained, however, was the survival of large numbers of enteroviruses in sludges at pH 3.5, a pH at which some anionic detergents commonly present in sewage are rapidly virucidal. The long survival of enteroviruses in these sludges at 5 deg C indicates that such sludges can probably be stored under refrigeration in the laboratory for extended periods while awaiting processing without suffering significant losses in enterovirus numbers and that the sludges require appropriate treatment before discharge to the environment. (Alexander-PTT)
W88-07026

EFFLUENT TREATMENT STANDARDS FOR THE FUTURE USING THE RESOURCES OF TODAY,
D. S. Buckley.
European Water and Sewage, Vol. 91, No. 1094, p 152-153, April 1987. 4 fig.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Water quality standards, *Activated sludge process, *Pollution load, Hydrogen ion concentration, Biomass, Design standards, Engineering, Training, Asia, Population equivalents.

NSW Environmental Systems has evolved a biological treatment system in which the formation of volatile compounds and organic acids which inhibit digestion is prevented by seeding the raw sludge with sufficient well-digested sludge, by maintaining a slightly alkaline condition with a pH of around 7.2 and by the avoidance of overloading with raw sludge. The preliminary treatment stage utilizes a two-story sedimentation and sludge digestion tank system. In the biological stage, the dissolved pollutants, that are not removed during the preliminary treatment undergo full biological treatment. The rotors are equipped with Bio-Net plastic media which as a result of its open network structure and the corresponding large specific surface area, ensures intensive aeration of both the tank contents and the biomass attached to the rotor. The modular engineering design and the fact that the process technology is the same for a plant of 150 population equivalents as that for 20,000 population equivalents means that the major problems confronting authorities and other responsible organizations can be solved now, i.e. full biological sewage treatment without environmental nuisance and without the need to train specialist plant operating personnel. (Alexander-PTT)
W88-07056

ANAEROBIC WASTEWATER TREATMENT WITH THE BIOTHANE PROCESS,
A. J. M. L. Borghans, W. M. A. Van Gils, and C. J. Van Schaijk.
European Water and Sewage, Vol. 91, No. 1091, p 27, 29, January 1987. 1 fig, 3 tab, 3 ref.

Descriptors: *Biothane reactors, *Wastewater treatment, *Anaerobic conditions, *Anaerobic digestion, *Chemical oxygen demand, Pollution load, Industrial wastewater, Effluents, Sugar industry, Load distribution.

In 1972 the Centrale Suiker Maatschappij (CSM) started a research program in cooperation with a number of universities in the Netherlands in order to develop an anaerobic wastewater treatment process. Their mutual efforts resulted in the development of the Biothane Upflow Anaerobic Sludge Blanket (UASB) reactor. All installations appear to function well; at COD loads of 10-30 kg/cu m day purification efficiencies of 70-98 per cent, based on the total COD and 85-98 per cent, based on dissolved COD are obtained. One of the most important aspects of the Biothane system is the high sludge concentration in the reactor. On the one hand this is caused by a good gas/liquid/sludge separation in the Biothane settler tank and on the other hand by the formation of a good sedimentable granulated sludge. Even at very high gas production, a loss of sludge hardly occurs. It can be concluded from this review that the anaerobic treatment of wastewater in Biothane reactors has become a nature technology. Wastewaters from the sugar industry are treated at loadings rates up to 30 kg/cu m with more than 80 per cent COD reduction. The system has shown to be highly resistant to variations in loading rate. (Alexander-PTT)
W88-07058

REMOVAL AND RECOVERY OF HEAVY METALS BY ION EXCHANGE FIBER,
Dept. of Chemical Engineering, Nagoya Univ., Nagoya 464.
M. Goto, and S. Goto.
Journal of Chemical Engineering of Japan JCEJAQ, Vol. 20, No. 5, October 1987. 10 fig, 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Ion exchange, *Isotherms, *Adsorption, *Copper, Breakthrough curves, Ions, Metals.

A cation exchange fiber and chelating fiber were studied for use in removing copper ions from water and wastewater. Equilibrium isotherms were measured for both fibers. Adsorption breakthrough and desorption curves for the fixed bed of fibers were compared with those for conventional spherical resins. Overall volumetric coefficients were evaluated from the breakthrough curves and then the contributions of respective mass transfer processes were estimated. Also, pressure drops in the fixed bed could be controlled by use of beds with large ratios of surface to volume. (Author's abstract)
W88-07060

OZONATION OF ORGANIC REFRACTORY COMPOUNDS IN WATER IN COMBINATION WITH UV RADIATION,
Kyushu Univ., Fukuoka (Japan). Dept. of Applied Chemistry.
For primary bibliographic entry see Field 5F.
W88-07061

BACTERIAL LEACHING OF METALS FROM DIGESTED SEWAGE SLUDGE,
Universite du Quebec, INRS-Eau, C. P. 7500, 2700 rue Einstein, Sainte-Foy, (Quebec), Canada G1V4C7.
R. D. Tyagi, and D. Couillard.
Process Biochemistry PRBCAP, Vol. 22, No. 4, p 114-117, August 1987. 4 fig, 3 tab, 40 ref.

Descriptors: *Water pollution sources, *Wastewater treatment, *Bacterial leaching, *Activated sludge process, *Heavy metals, *Anaerobic digestion, *Culturing techniques, Zinc, Copper, Lead, Cadmium, Leachates, Metals, Bacteria.

Bacterial leaching of heavy metals from anaerobically digested sludge was studied in batch system using mixed culture of Thiobacillus ferrooxidans and Thiobacillus thiooxidans. The leaching was carried out in five litre bioreactor at 24 deg C and pH 4.0. Mixed culture gave better solubilization rate compared to that for single culture. The maximum metal solubilization observed in mixed culture for Zn, Cu, Pb, and Cd was in the order of 96%, 75%, 55%, and 50% respectively in 10 to 12 days. The rate of solubilization in the order of Cu > Pb > Zn > Cd was observed. The recommended level of Cu in sludge (74% removal) was obtained in seven days. (Author's abstract)
W88-07062

PATHOGENIC MICRO-ORGANISMS AND HELMINTHS IN SEWAGE PRODUCTS, ARABIAN GULF, COUNTRY OF BAHRAIN,
Biological Sciences, Univ. of Wisconsin-Parkside, Box No. 2000, Kenosha, WI 53151-2000.
O. M. Amin.
American Journal of Public Health AJHEAA, Vol. 78, No. 3, p 314-315, March 1988. 1 tab, 10 ref.

Descriptors: *Wastewater analysis, *Platygelminthes, *Coliforms, *Escherichia coli, *Poliovirus, *Microorganisms, *Pathogens, *Bahrain, Wastewater treatment, Wastewater, Feces, Sludge, Public health, Viruses.

Fecal and sludge samples from the Arabian Gulf country of Bahrain contained poliomyelitis and coxsackie viruses, coliform bacteria, Escherichia coli, Salmonella spp., Shigella sonni, fecal streptococci, Balantidium coli, Ascaris lumbricoides and Hymenolepis nana eggs, and Strongyloides stercoralis. Sludge produced in the central sewage treatment plant is used for agricultural purposes and poses a threat to public health. Recommendations to reduce the potential health hazards are made. (Author's abstract)
W88-07067

FERMENTATION OF 2-METHOXYETHANOL BY ACETOBACTERIUM MALICUM SP. NOV. AND PELOBACTER VENETIANUS,
Konstanz Univ. (Germany, F.R.). Fakultaet fuer Biologie.
K. Tanaka, and N. Pfennig.
Archives of Microbiology AMICCU, Vol. 149, No. 3, January 1988. 3 fig, 3 tab, 19 ref.

Descriptors: *Acetobacterium, *Wastewater treatment, *Biodegradation, *Fermentation, *Aerobic bacteria, Culturing techniques, Organic compounds, Microorganisms, Microbiological studies, Bacteria, Temperature.

Anaerobic bacteria degrading 2-methoxyethanol were enriched from freshwater sediments, and three strains were isolated in pure culture. Two of them were Gram positive non-spore-forming rods and grew strictly anaerobically by acetogenic fermentation. Optimal growth occurred at 30 deg C, initial pH 7.5-8.0. 2-methoxyethanol and 2-ethoxyethanol were fermented to acetate and corresponding alcohols. Hydrogen plus carbon dioxide, formate, acetoin, L-malate, lactate, pyruvate, fructose, and methoxyl groups of 3,4,5-trimethoxybenzoate and 3,4,5-trimethoxycinnamate were fermented to acetate. 1,2-Propanediol was fermented to acetate, propionate, and propanol. Strain MuME1 was described as a new species, Acetobacterium malicum. It had a DNA base composition of 44.1 mole-percent guanine plus cytosine. The third strain, which was identified as Pelobacter venetianus, fermented 2-methoxyethanol to methanol, ethanol, and acetate. (Author's abstract)
W88-07068

RECYCLING OF THE AQUATIC WEED, WATER HYACINTH, AND ANIMAL WASTES IN THE REARING OF INDIAN MAJOR CARPS,
Central Institute of Freshwater Aquaculture (ICAR), Kausalagang, Via: Bhubaneswar 751002, Orissa (India).
B. K. Mishra, A. K. Sahu, and K. C. Pani.
Aquaculture AQCLAL, Vol. 68, No. 1, p 59-64, January 1988. 2 tab, 19 ref.

Descriptors: *Biological wastewater treatment, *Barn wastewater, *Aquatic weeds, *Water hyacinth, *Biogas slurry, *India, *Animal wastes, *Recycling, *Waste recovery, *Rearing ponds, *Carp, Fish, Fish ponds, Wastewater treatment.

The efficacy of recycling cattle wastes and the aquatic weed, water hyacinth, in the rearing ponds for Indian major carps was studied. No other input was provided. It was observed that addition of the weed alone (treatment A) increased fish production by about 52% as compared to the control (treatment D) with no input. A combination of cattleshed washings and biogas slurry (treatment B) increased fish production by about 126% as compared to the control. A combined treatment with biogas slurry, cattleshed washings and water hyacinth (treatment C) gave the maximum production, about 170% higher than the control. The average gross/net productions obtained after one year of rearing for treatments A, B, C and D were 945/794.8, 1409.5/1258.05, 1679/1526.1, and 622/494.45 kg/ha/yr, respectively. (Author's abstract)
W88-07119

DDT DEGRADATION BY BACTERIA FROM ACTIVATED SLUDGE,
Department of Chemistry, Lady Irwin College, University of Delhi, Sikandra Road, New Delhi-110 001, India.
K. V. Sharma, and J. M. Sadasivam.
Environment International ENVIDV, Vol. 13, No. 2, p 183-190, 1987. 4 fig, 4 tab, 6 ref.

Descriptors: *Biodegradation, *Biological wastewater treatment, *Mixed liquor, *Insecticides, *Degradation, *Bacteria, Bacterial isolates, *Activated sludge, *Microbial degradation, India, DDE, DDD, Degradation products, Chlorinated hydrocarbons.

The degradation of DDT in aqueous phase was studied by treating it with microflora present in activated sludge developed in bench-scale reactors and in vitro by incubating it with mixed liquor from the activated sludge and with the bacteria obtained after enrichment of the mixed liquor culture through repeated transfers with increasing doses of DDT in standard inorganic medium. Several strains of bacterial isolates as well as mixed culture were able to degrade DDT with hardly any formation of the stable metabolites DDD or DDE. The activated sludge degraded DDT (1 to 55 mg/L) almost completely within 23 h, as only some of the effluent samples contained DDTs up to 0.03 mg/L. The bacteria belonged to the genera Bacillus, Micrococcus, Pseudomonas, and Flavobacterium. The mixed liquor and individual bacteria, when incubated with DDT in a mineral medium for 42 days under static culture conditions brought about 50% to 74% and 44% to 69% degradation of DDT, respectively. Under shaked conditions, these bacteria, when incubated up to 1 month with 50,200 and 500 mg/L DDT, showed 5.3% to 76.6% degradation of DDT, respectively. Traces of DDE and DDD were detected in a few samples. The microorganisms could utilize DDT as a source of carbon and hence can be used for biotreatment of DDT. (Author's abstract)
W88-07127

PROBLEMS WITH THE PARAMETRIC ADJUSTMENT OF GROWTH MODELS IN BIOLOGICAL TREATMENT (PROBLEMES DE L'IDENTIFICATION PARAMETRIQUE DES MODELESDE CROISSANCE EN TRAITEMENT BIOLOGIQUE),
Ecole Nationale des Ingenieurs de Tunis (Tunisia).
H. Sayeb, B. Capdeville, M. Roustan, and H. Roques.
Environmental Technology Letters ETLEDB, Vol. 8, No. 6, p 307-316, June 1987. 1 fig, 10 tab, 10 ref.

Descriptors: *Biological wastewater treatment, *Microbial growth, *Wastewater treatment process, *Parameter adjustment, *Wastewater treatment, *Model studies, Growth models, Mathematical models.

The parametric adjustment of the growth models in biological treatment is an important step for the modeling of the wastewater treatment process. Two methods of adjustment have been used (Hooke and Jeeves; Newton-Gauss) to estimate the parameters of five growth models. It should be noted that the good adjustment of these parameters does not imply the validity of the model. It is essential to determine the experimental domain utilized to identify these parameters. (Author's abstract)
W88-07136

ANAEROBIC PRETREATMENT OF CONCENTRATED PHARMACEUTICAL WASTES,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
S. Shafai, and J. A. Oleszkiewicz.
Environmental Technology Letters ETLEDB, Vol. 8, No. 7, p 327-338, July 1987. 6 fig, 1 tab, 18 ref.

Descriptors: *Wastewater, *Pharmaceutical wastes, *Pretreatment of wastewater, *Ammonification, *Anaerobic reactors, Raw wastewater, Ammonia Nitrogen, Total Dissolved Solids, Organic Carbon, Bioassay, Continuous flow, Chemical Oxygen Demand.

A study was conducted to investigate the anaerobic ammonification of wastewater from an estrogen extracting pharmaceutical plant. The wastewater was very high in Total Dissolved Solids (TDS), nitrogen (TKN) and organic Carbon (TOC). Both flow-through and batch anaerobic reactors were used. TDS concentrations over 17 g L in the flow-through reactors and in excess of 10 g L in the batch reactors were found to be inhibitory to both ammonification and methanogenesis. (Author's abstract)
W88-07138

CAD COMPARISONS FOR WASTEWATER TREATMENT FACILITIES,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
D. B. Getty, A. D. Koussis, and F. L. Parker.
Environmental Technology Letters ETLEDB, Vol. 8, No. 9, p 405-418, September 1987. 1 fig, 2 tab, 9 ref. EPA Grant Subcontract 7821-X04.

Descriptors: *Computer aided design, *Model studies, *Computer programs, Estimating equations, *Wastewater treatment, *United States, Primary clarification, Secondary clarification, Aerobic digestion, Vacuum filtration, Incineration, Sludge hauling, Landfills, Activated sludge, Trickling filtration, Drying beds, Gravity thickening.

A comparison was made between two computer aided design (CAD) models for wastewater treatment facilities, CAPDET and EXEC/OP, which are widely used in the United States. The purpose of both programs is to optimize preliminary designs and to determine costs for municipal wastewater treatment plants. However, the size, capabilities and computational procedures are vastly different. CAPDET is a much larger program than EXEC/OP, provides a larger selection of unit operations and has a more refined costing scheme. CAPDET was found to be user-friendlier once installed on a mainframe computer system. Testing of their operational and design capabilities against a consultant's designs has shown that, despite their flaws, both programs fulfill their intended purpose satisfactorily. (Author's abstract)
W88-07143

BENEFITS OF USING SELECTIVE INHIBITION TO REMOVE NITROGEN FROM HIGHLY NITROGENOUS WASTES,
NovaTec Consultants Inc., Vancouver, B.C., Canada.
O. Turk, and D. S. Mavinic.
Environmental Technology Letters ETLEDB, Vol. 8, No. 9, p 419-426, September 1987. 3 fig, 1 tab, 22 ref.

Descriptors: *Wastewater treatment, *Nitrites, *Nitrates, *Economic aspects, *Selective inhibition, *Volatile suspended solids, Nitrification, Denitrification, Chemical Oxygen Demand, Continuous flow, Activated sludge, Cost.

A research program was conducted to demonstrate the feasibilty of using selective inhibition as a means of achieving cost reductions in the removal of nitrogen from wastewater (by means of biological nitrification/denitrification). Continuous-flow, activated sludge systems and a batch test showed that nitrite reduction rates were 63% higher than nitrate reduction rates; COD consumption rates were 40% lower for nitrite reduction than for nitrate reduction; and biomass production up to 300% lower with the reduction of nitrite than with

nitrate. Nitrite build-up was achieved by selectively inhibiting the nitrite oxidation step. Nitrite levels as high as 115 mg NO2(-)/l caused no inhibition to the biological system. The findings call for a reassessment of the traditional approach to wastewater treatment of highly nitrogenous wastes. (Miller-PTT)
W88-07144

NICKEL ACCUMULATION BY BACTERIA,
Department d'Enginyeria Quimica i Bioquimica, Facultat de Quimiques, Universitat de Barcelona, Placa Imperial Tarraco, 1, 43005 Tarragona, Spain.
For primary bibliographic entry see Field 5B.
W88-07152

CHEMICALLY ASSISTED PHOSPHOROUS PRECIPITATION: EFFECTS ON ANAEROBIC DIGESTION AND 'AERCON' SLUDGE THICKENING,
Civil Engineering Department, Imperial College, London, SW7 2BU, U.K.
P. W. W. Kirk, M. Hunter, J. N. Lester, and R. Perry.
Environmental Technology Letters ETLEDB, Vol. 8, No. 11, p 545-554, November 1987. 4 tab, 25 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Sludge thickening, *Coagulant sludges, *Alum sludge, *Chemical precipitation, Phosphorus removal, Phosphorus, Sedimentation, Aluminum sulfate, Ferric chloride, United Kingdom.

Removal of phosphorus by chemically assisted primary sedimentation was assessed and its effects on anaerobic digestion and Aercon consolidation were examined. Phosphorus removals in excess of 96 and 99% were evident with the addition of aluminum sulfate and ferric chloride coagulants, respectively. Further improvement of phosphorus removal was minimal with the application of a polymeric flocculation aid in combination with ferric chloride only. No adverse effects on amenability to anaerobic digestion were observed for coagulant sludges. Subsequently, 'Aercon' treatment was able to thicken ferric chloride and aluminum sulfate sludges satisfactorily, thereby proving 'Aercon' applicable in such situations. (Author's abstract)
W88-07154

RBC CHARACTERISTICS FOR NEJAYOTE AEROBIC TREATMENT,
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica.
R. P. Brenes, and C. D. Bazua.
Environmental Technology Letters ETLEDB, Vol. 8, No. 11, p 579-588, November 1987. 4 fig, 3 tab, 14 ref.

Descriptors: *Wastewater treatment, *Aerobic treatment, *Food-processing wastes, *Biological wastewater treatment, *Rotating biological contactor, Effluents, Organic compounds, Chemical oxygen demand, *Microorganisms, *Nejayote, Corn, Maize.

Corn processing effluents, known as nejayote, were aerobically treated in a lab scale rotating biological contactor. Effluent organic compounds removal was monitored as chemical oxygen demand and reducing sugars. Results showed selective elimination of organic compounds along the cascade by microorganisms, corroborating previous hypothesis on staged removal of maize wastes pollutants by adapted biocommunities. (Author's abstract)
W88-07156

PHOSPHATE REMOVAL BY COLUMN PACKED BLAST FURNACE SLAG: I. FUNDAMENTAL RESEARCH BY SYNTHETIC WASTEWATER,
Department of Environmental Science, Faculty of Engineering and Laboratory of Marine Biochemistry, Faculty of Applied Biological Science, Hiroshima University, Higashi-Hiroshima City, 724 JAPAN.
H. Sunahara, W. M. Xie, and M. Kayama.
Environmental Technology Letters ETLEDB, Vol. 8, No. 11, p 589-598, November 1987. 7 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Synthetic wastewater, *Phosphate removal, *Blast furnace slag, Decarbonation, Secondary effluent.

The removal of phosphate ion from secondary effluents using a contact filtration process was investigated. A synthetic wastewater prepared by using K2SO4, NaHCO3, CaCl2, and KH2PO4 without COD and BOD components, and without suspended solids or total nitrogen was passed through a column packed with blast furnace slag. The wastewater was made to approximate the secondary effluent from an activated sludge process. Decarbonation was necessary before phosphate removal and was accomplished by CO2-stripping at pH 3.9-4.5. The decarbonated wastewater was fed to the slag column by upflow. The highest phosphate removal was achieved under the following conditions: Ca(-) concentration 80 mg/l; total carbonate $<$ 15 mg/l as CO2; pH at 7-9; and retention time $>$ 24 min. (See also W88-07158) (Miller-PTT)
W88-07157

PHOSPHATE REMOVAL BY COLUMN PACKED BLAST FURNACE SLAG: II. PRACTICAL APPLICATION OF SECONDARY EFFLUENT,
Department of Environmental Science, Faculty of engineering, Hiroshima University, Higashi-Hiroshima City, 724 JAPAN.
W. M. Xie, X. C. Zhang, T. Kitaide, and H. Sunahara.
Environmental Technology Letters ETLEDB, Vol. 8, No. 11, p 599-608, November 1987. 8 fig, 5 tab, 4 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Secondary wastewater treatment, *Phosphate removal, Calcium ion, Decarbonation.

Phosphate removal by a blast furnace slag-packed column was applied to a a secondary effluent from an activated sludge sewage treatment facility. The necessary calcium ion for phosphate removal was supplied by using a calcium feeder column packed with converter slag. The concentration of calcium ion and pH were adjusted at 90 mgl-1 and pH 7-9. The secondary effluent was decarbonated by the contact CO2-stripping method to $<$15 mg/l as CO2. The Ca(-) concentration in the slag column was automatically controlled using a Ca ion selective electrode and an ion strength adjusting solution of 2.2 M NaCl. The regeneration of the blast furnace slag was investigated by two methods: back washing using the treated water and standstill by halting the influent. Although the standstill method was more effective, it was too time consuming to be practical. (See also W88-07157) (Author's abstract)
W88-07158

REVERSIBLE AND IRREVERSIBLE INHIBITION OF METABOLIC ACTIVITY IN BIOLOGICAL PHOSPHORUS REMOVAL SYSTEMS,
Santa Clara Univ., CA. Dept. of Civil Engineering.
S. C. Chiesa, J. A. Postiglione, and S. R. Linne.
Environmental Technology Letters ETLEDB, Vol. 8, No. 12, p 609-618, December 1987. 1 fig, 3 tab, 32 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Anaerobic conditions, *Phosphorus removal, *Biological wastewater treatment, *Inhibitors, Copper, Cyanide, Phenols.

Biological phosphorus removal was inhibited to varying degrees by short-term exposure to copper, cyanide and phenol. Anaerobic phosphorus release was either unaffected or stimulated in the presence of inhibitory agents. Both copper and cyanide severely inhibited aerobic phosphorus uptake. Inhibitory metabolic effects associated with cyanide could be reversed by removing the compound from solution. Copper-induced inhibition could not be reversed by simple washing, even after prolonged aeration. Short-term exposure to phenol, at concentrations up to 150 mg/l, had relatively little effect on the phosphorus accumulating cultures. (Author's abstract)
W88-07159

ACCLIMATION OF ANAEROBIC FLUIDISED BEDS TO TWO PHARMACEUTICAL WASTES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. M. Stronach, T. Rudd, and J. N. Lester.
Environmental Technology Letters ETLEDB, Vol. 8, No. 12, p 673-687, December 1987. 8 fig, 3 tab, 19 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Acclimatization, *Organic wastes, *Pharmaceutical wasteswater, *Industrial wasteswater, Methanogenesis, Chemical oxygen demand, Propanol, Dimethyl formamide, England, Fluidized bed process.

The acclimation of anaerobic fluidized beds to two pharmaceutical wastes gradually introduced with the influent feed was examined. Feed was applied at a COD concentration of 2500 mg/l, at an organic loading rate of 4.5 kg COD/cu m and with a hydraulic retention time (HRT) of 0.53 d, and operation continued until the feed comprised 100% industrial waste. Final COD removals reached 54% and 45% for the propanol (A) and the dimethylformamide (B) containing wastes, respectively. Analytical results suggested that waste A was nutrient limited and caused inhibition of methanogenesis, whereas waste B appeared to contain a non-biodegradable or toxic fraction which did not inhibit methanogenesis but caused a reduction in COD removal and erratic volatile acids production. (Author's abstract)
W88-07161

MODELING NUTRIENT BEHAVIOR IN WETLANDS,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
R. H. Kadlec, and D. E. Hammer.
Ecological Modelling ECMODT, Vol. 40, No. 1, p 37-66, January 1988. 9 fig, 4 tab, 23 ref.

Descriptors: *Mathematical models, *Cycling nutrients, *Wetlands, *Wastewater treatment, *Wastewater irrigation, Hydrologic models, Simulation analysis, Computer models, Differential equations, Finite difference methods, Wastewater facilities, Biomass, Plant growth, Litter, Soil genesis, Surface water, Overland flow, Interstitial water, Solutes, Phosphorus, Nitrogen, Chlorides, Michigan.

A simple mathematical model was developed which permits dynamic simulation of wetland hydrology and of nutrient-driven interactions between wastewater and the wetland ecosystem. Spatial variations due to surface water flow are described, and material balance calculations carried out for phosphorus, nitrogen, and chloride. A hydrology model, described elsewhere, predicts overland flow. Ecosystem phenomena are represented, using a one-dimensional spatially distributed compartmental model. Compartments representing active parts of the ecosystem include soil, surface water, interstitial soil water, and various types of live biomass, standing dead, and litter. Solutions to the partial differential equations which comprise these spatial models are demonstrated using finite-difference methods. Computer simulations were compared with operating data from the Porter Ranch wastewater treatment facility at Houghton Lake, Michigan. They accurately predicted solute concentrations in surface water, biomass growth patterns, changes in the litter pool, and soil accretion rates. (Author's abstract)
W88-07164

SELECTION OF MEMBRANES FOR TREATMENT OF BLEACHING EFFLUENTS,
Alfa-Laval Separation AB, Filtration Technology, P.O. Box 500, S-147 00 Tumba, Sweden.

P. Zadorecki.
Desalination DSLNAH, Vol. 62, p 137-147, May 1987. 8 fig, 3 tab, 12 ref.

Descriptors: *Wastewater treatment, *Membrane processes, *Reverse osmosis, *Ultrafiltration, *Bleaching wastes, *Pulp and paper industry, *Kraft mills, Effluents, Bacterial degradation, Polysulfone membrane, Chemical oxygen demand.

Ultrafiltration is used for decoloration and reduction of the high-molecular weight lignin content in effluents from the alkali-extraction stage of a conventional kraft pulp mill bleaching. However, this classical ultrafiltration does not reduce the amount of the most toxic low-molecular weight chlorinated phenols. A joint research program is described that aims at total purification of effluents from a bleach plant by means of a membrane process integrated with a bacterial degradation. Both reverse osmosis (RO) membranes and several different ultrafiltration (UF) membranes were evaluated in various operating conditions. Reduction of COD was only slightly higher when RO membranes were used, compared with the UF membranes. The different UF membranes performed differently under various conditions. The best results regarding rejection and flux were obtained with a UF polysulfone membrane with finger structure, operating at high pressure. (Author's abstract)
W88-07217

APPLICATION OF MEMBRANES IN ENVIRONMENTAL PROTECTION,
Institute of Environmental Chemistry, Chinese Academy of Science, P.O. Box 934, Beijing, China.
T.-H. Liu.
Desalination DSLNAH, Vol. 62, p 149-164, May 1987. 9 fig, 6 tab, 16 ref.

Descriptors: *Wastewater treatment, *Ultrafiltration, *Membrane processes, *Reverse osmosis, Environmental protection, Process water, Oil waste, Dyes, Textiles.

In the last decade, research at the Institute of Environmental Chemistry has focused on four main areas: (1) Research into and preparation of membranes from polysulfone, polyvinylidene fluoride, sulfonated polysulfone, and a polyether sulfone with a phenolphthalein lateral group; (2) The development of methods and apparatus for membrane research; (3) The design of ultrafiltration (UF) membrane modules and systems; (4) And applications of UF. In this paper, work on reverse osmosis and ultrafiltration membranes and their applications in environmental protection and treatment of process waters is summarized. Applications of UF that are described briefly are: recovery of color film developing solution; reclamation of textile oil (spin finishes); dye reclamation in the printing and dyeing industry; and treatment of crude oil wastewater. (Author's abstract)
W88-07218

DEVELOPMENT OF POLYSULFONAMIDE MEMBRANE AND ITS APPLICATION IN TREATING CHROMIUM PLATING WASTEWATER,
The Beijing Municipal Research Institute of Environmental Protection, Fu Wai Avenue, Beijing, China.
G. Liu, and J. Wu.
Desalination DSLNAH, Vol. 62, p 239-249, May 1987. 8 fig, 8 tab.

Descriptors: *Membrane processes, *Reverse osmosis, *Wastewater treatment, *Wastewater facilities, Chromium plating wastewater, Polysulfonamide membrane, Process water.

This paper presents the method of preparation of polysulfonamide (PSA) membranes and discusses their properties. Because of its acid-resistance, oxidation-resistance and heat-resistance, PSA membrane is highly suitable for reverse osmosis (RO) units. It is made of home-made material which is cheap to produce, and as the casting technology is simple, it should be easy to commercialize. When the PSA membrane RO unit is used in treating chromium plating wastewater, it offers the following advantages: it has a high recovery rate, takes up little space, is straightforward to operate and leaves no sediment. However, the water flux of the membrane can be improved and its compressibility can be reduced still further. PSA membranes are suitable for treating electroplating wastewater over a wide pH range. (Brock-PTT)
W88-07219

INFLUENCE OF DIFFERENT TYPES OF METAL COMPLEX ON THE TRANSITIVITY OF REVERSE OSMOSIS MEMBRANES,
Department of Chemical Engineering and Environmental Engineering, Laboratory for Environmental Protection Research, Beijing Polytechnic University, Beijing, China.
A.-L. Ling, Y.-Y. Gao, and Z.-Z. Wang.
Desalination DSLNAH, Vol. 62, p 377-394, May 1987. 3 fig, 13 tab, 3 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Wastewater treatment, Plating baths, Metal complexes, Transitivity, Polysulfonamide, Cellulose acetate, Process water, Salts, Enzymes, Osotic pressure.

The influence of various types of complexes in plating baths (salts of cyanogen complexes, amines, organic salt, organic polyphosphatase, etc.) on the transitivity of polysulfonamide and cellulose acetate reverse osmosis membranes was studied. That the presence of a complex in the plating bath causes the osmotic pressure of the solution and consequently the water flux of the membrane to change. Because the stability, concentration and volume of complex ions are different for various types of complexes, the transitivity of the membrane also differs. The greater the stability, volume and concentration of complex ions and the more different kinds of ions in the plating bath, the lower the conductimetric rejection and water flux. It is difficult to treat such rinse water using only reverse osmosis technology; for effective treatment, reverse osmosis needs to be combined with some other process. Only when the reduction in transitivity is small may rinse water be treated by reverse osmosis alone. (Author's abstract)
W88-07220

SIGNIFICANCE OF COLOUR CHANGES IN SOME REVERSE OSMOSIS PERMEATORS,
N. R. G. Walton.
Desalination DSLNAH, Vol. 68, No. 1, p 29-33, January 1988.

Descriptors: *Reverse osmosis, *Membrane processes, *Light, Color, *Plastics, *Fouling, Biological growth, Wastewater facilities, Microorganisms, Light quality.

The apparent irrelevance of color to reverse osmosis permeators is discussed in the light of accumulating evidence for the need to prevent light translucency in water-retaining vessels to minimize biological growth. Light promotes external (UV) attack on all plastic materials, and stimulates internal growth of micro-organisms. Both of these processes can lead to color-changes in translucent fiber-reinforced plastic (FRP) resins; DuPont B-9 and other translucent FRP shells are susceptible to both of these processes, which cause slight color changes to the external shell appearance, although promotion of biological growth is the most serious from an operational point of view. The internal FRP shell surface, on a microscopic scale, is quite rough, and provides an ideal substrate for initial colonization and growth of microorganisms. This paper identifies light as a proven biological stimulant and recommends that it be totally eliminated from RO plants by painting and/or replacement of all translucent parts. Even pin-pricks of light have been found to cause considerable algal growth in filters at some distance (several feet) from the light source. Translucent end-plugs in both new and stored permeators from any manufacturer of any permeators should be replaced by opaque plugs. Artificial fluorescent light sources (inside buildings) appear to be more efficient at promoting biological growth than indirect (shaded) sunlight. Ultimately, the best remedy must be to include a suitable dark colored pigment into the resin during the manufacture of FRP pipes, tanks, shells, etc., since the cost of such a simple addition is negligible compared with the cost and effort involved in internal cleaning and external painting FRP components once they are installed on site. The total exclusion of light should be seen as an important design parameter for any new RO plant. The recent practice of using locally manufactured FRP shells for on-site permeator assembly requires more stringent specifications to eliminate translucency. (Brock-PTT)
W88-07221

TREATMENT OF URANIUM CONTAINING EFFLUENTS WITH REVERSE OSMOSIS PROCESS,
Department of Materials Engineering, National Cheng Kung University, Tainan, Taiwan.
K. L. Lin, M. L. Chu, and M. C. Shieh.
Desalination DSLNAH, Vol. 61, No. 2, p 125-136, September 1987. 7 fig, 3 tab, 11 ref.

Descriptors: *Wastewater treatment, *Uranium, *Waste recovery, *Effluents, *Reverse osmosis, Industrial wastewater, Separation techniques, Membrane processes, Nitrates, Ammonium.

Modest energy consumption is one of the main advantages of the membrane separation process over many other conventional separation processes. Reverse osmosis (RO) has become one of the most important membrane processes in industrial applications. The present work reports on an RO study on the rejection of uranium and coexisting species, such as nitrate and ammonium from uranium conversion process effluents. The uranium in effluents with concentrations ranging from a few micrograms/ml to 3780 micrograms/ml, at pH 2.0 to pH 10.0, has been successfully rejected with continuous-feedback RO. The rejection rates for uranium, increasing with increasing operating pressure and feed concentration, are 97-99.5%. It is possible to concentrate the rejected uranium streams with continuous feedback operation. The concentration of the uranium in the permeate water is as low as < 0.1 microgram/ml (for a few micrograms/ml feed) to 4 micrograms/ml (for 3780 micrograms/ml feed). The rejection rates of the coexisting nitrate are 96-99.5%, whereas the rejection rate for ammonium is $< 50\%$ at low feed concentration and $> 96\%$ at high feed concentration. (Author's abstract)
W88-07227

DESALINATION OF AGRICULTURAL DRAINAGE RETURN WATER: I. OPERATIONAL EXPERIENCES WITH CONVENTIONAL AND NONCONVENTIONAL PRETREATMENT METHODS,
Brown and Caldwell, Pleasant Hill, CA.
A. C. Molseed, J. R. Hunt, and M. W. Cowin.
Desalination DSLNAH, Vol. 61, No. 2, p 249-262, September 1987. 7 fig, 2 tab, 10 ref.

Descriptors: *Drainage water, *Return water, *Agricultural runoff, *Pretreatment of water, *Reverse osmosis, Particulate matter, Filtration, Flocculation, Ponds, Clarification, Gravity filters, Ion exchange, Turbidity, Suspended solids, Particle size, California.

The State of California Department of Water Resources is currently operating a demonstration reverse osmosis facility at Los Banos, California, which is treating agricultural drainage water. The pretreatment system at this plant at the time of this study consisted of marsh ponds and an upflow reactor clarifier which were operated in parallel, followed by gravity filtration, ion exchange, and cartridge filters. This system was monitored using conventional turbidity and silt density index measurements. Since neither of these parameters provides an adequate characterization of suspended particles, the techniques were supplemented with measurements of direct particle size distributions throughout the pretreatment system. During the summer and fall of 1985, the Demonstration Facility successfully removed particles from drainage waters. The reactor clarifier, operating at alum

doses of 50-75 mg/l and cationic polymer doses of 4 mg/l, was able to consistently lower drainage water turbidities from the 1-10 NTU range down to 1.0 NTU and could dampen out fluctuations in turbidities observed in drainage waters during high winds. Filtered reactor clarifier effluent was typically 0.1 NTU and its silt density index was usually below 5.0. Particle size distribution data confirmed that micrometer and larger-sized particles were effectively removed. (See also W88-07230) (Author's abstract)
W88-07229

DESALINATION OF AGRICULTURAL DRAINAGE RETURN WATER: II. ANALYSIS OF THE PERFORMANCE OF A 13,000 GDP RO UNIT,
California Univ., Berkeley. Dept. of Sanitary and Environmental Engineering.
B. J. Marinas, and R. E. Selleck.
Desalination DSLNAH, Vol. 61, No. 2, p 263-274, September 1987. 3 fig, 4 tab, 7 ref, append. California Department of Water Resources Agreement B-55037 Task Order 85-1.

Descriptors: *Water treatment, *Reverse osmosis, *Hyperfiltration, *Desalination, *Selenium, *Nitrates, *Return water, *Agricultural runoff, *Drainage water, *Fouling, Water treatment facilities, Water reuse, Membrane processes, Scaling, Water pressure, Temperature, Hydrogen ion concentration, Hardness, Conductivity, Water flow, Calcium, Dissolved solids, Sodium, Sulfates, Chlorides, Nitrates, Alkalinity, Boron, California, Field tests.

The reverse osmosis (RO) system of the Los Banos Desalting Demonstration Facility was designed to treat 1440 cu m/d (380,000 gpd) of water from the San Luis Drain at an 85 to 92% product water recovery. In order to ascertain whether fouling and scaling will occur, a relatively small-scale low-pressure RO unit was installed at the plant and operated continuously for 1527 h during the period June 4 to August 8, 1985. The single-stage RO unit consisted of six spiral-wound membrane elements placed in series. Every two hours determinations were made of feed water pressure, temperature, pH, calcium hardness, total hardness, and conductivity; reject water pressure, conductivity, flow, and calcium hardness; and product water pressure, flow, and calcium hardness. The daily performance of the 49 cu m/d RO unit is reported in terms of the water and total dissolved solids transport parameters A and B, respectively. The rejections of the sodium, sulfate, chloride, and nitrate ions and alkalinity, boron, and selenium are also reported for the beginning and end of the testing period. The results of this field test did not indicate any severe membrane fouling during the first 1500 h of operation. (See also W88-07229) (Shidler-PTT)
W88-07230

DESIGN OF REVERSE OSMOSIS PROCESS,
Department of Material Science and Chemical Engineering, Yokohama National University, Yokohama, Japan.
For primary bibliographic entry see Field 3A.
W88-07236

STATE SPACE APPROACH TO THE BEHAVIOUR OF SEWER SYSTEMS,
Sewer Department of Public Works, The City of Barcelona, Spain.
R. Vasquez Garcia.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 301-312, 1987. 4 fig, 9 ref.

Descriptors: *Sewer systems, *Storm sewers, *Mathematical models, *Mathematical equations, *Simulation, *Input-output analysis, Rainstorms, Flow discharge, Storm-overflow sewers, Combined sewer overflows, Weirs, Systems analysis, Systems engineering, Management planning, Automation, Spain.

A storm-sewer system can be considered as a mathematical entity mediating between rainstorms (input), and discharge at the system outlets (output). The state-space approach may be a useful tool in developing instructive procedures, building automatic control systems, and constructing simple simulation models related to flow routing through storm-sewer systems. Systems engineering provides many civil engineering examples in which the general methodology of the state-space approach fits the mathematical abstraction of physical reality quite well. By means of an equation developed in this study the evolution of discharges at different nodes of a sewer system can be followed in discrete form. A simple model called CSMUSK is in operation at the Planning Division of the Sewers Department of the City of Barcelona; it is used to test overflow weir behavior quickly. The model will be enhanced to simulate automatic weir control. (Shidler-PTT)
W88-07247

IMPACT OF NONCHLORINATED SECONDARY AND TERTIARY EFFLUENTS ON WARM WATER FISH COMMUNITIES,
Environmental and Chemical Sciences, Inc., P.O. Box 1393, Aiken, South Carolina 29802.
For primary bibliographic entry see Field 5C.
W88-07279

WASTE STABILIZATION PONDS IN EUROPE: A STATE OF THE ART REVIEW,
CEMAGREF, Division Qualite des Eaux, Peche et Pisciculture, 3 Quai Chauveau 69336 Lyon Cedex 09, France.
M. Vuillot, and C. Boutin.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 1-6, 1987. 1 fig, 1 tab, 15 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, Design criteria, Stabilization lagoons, Europe, Land disposal.

Waste stabilization ponds are used in 16 European countries. Information gathered from ten of these countries (most northerly, Denmark) are summarized. Two systems are used: (1) primary anaerobic ponds followed by one or more facultative ponds and (2) facultative treatment lines without anaerobic ponds. Applications include domestic wastes from small communities of <2000 inhabitants and tourist areas, agricultural and industrial wastes, and in tertiary treatment. New concepts in wastewater lagooning involve lagoons planted with rooted macrophytes, use of floating macrophytes, high-rate algal ponds, and ponds combined with trickling filter or rotating biological contactor. (Cassar-PTT)
W88-07316

WASTEWATER STABILIZATION LAGOON DESIGN CRITERIA FOR PORTUGAL,
Direccao-Geral da Qualidade do Ambiente, Avenida Almirante Gago Coutinho, 30, 5 - 1100 Lisboa, Portugal.
J. M. Gomes de Sousa.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 7-16, 1987. 1 fig, 15 tab, 7 ref.

Descriptors: *Wastewater treatment, *Design criteria, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, Stabilization lagoons, Portugal, Organic matter.

Raw wastewater characteristics and climactic factors were considered in wastewater stabilization lagoon design for Portugal. Two types of lagoons were studied: the classic line (anaerobic lagoon, facultative lagoon, and maturation lagoon) and the French line (facultative lagoon and two maturation lagoons). It was concluded that design recommendations in the literature and existing lagoons in Portugal led to overdesign, particularly in the anaerobic and facultative lagoons. Average removal efficiencies in the classic line were as follows: total BOD, 86%; soluble BOD, 94%; COD, 72%; total suspended solids, 85%;. Average removal efficiencies in the French line were as follows: total BOD, 87%; soluble BOD, 95%; COD, 79%; total suspended solids, 90%. Soluble BOD concentrations in the effluent generally met discharge requirements. However, the total suspended solids concentrations were higher than in secondary effluent because of the presence of algae. (Cassar-PTT)
W88-07317

GERMAN EXPERIENCES WITH SEWAGE TREATMENT PONDS,
Bayerisches Landesamt fur Wasserwirtschaft, Lazarettstrasse 67, D-800 Munchen, Federal Republic of Germany.
K. Bucksteeg.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 17-23, 1987. 13 fig, 1 tab, 15 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Storm water, *Organic loading, *Biological wastewater treatment, Stabilization lagoons, Germany, Rural areas, Cost analysis, Trickling filters, Chemical oxygen demand, Biological oxygen demand, Phosphates, Ammonium compounds.

Rural areas of Germany are served by three types of wastewater treatment ponds: (1) facultative ponds for communities of less than 1,000 inhabitants, (2) artificially aerated ponds for communities of 1,000 to 10,000 inhabitants, including food industries, and (3) ponds combined with trickling filters or rotating bio-filters for communities of 1,000 to 4,000 inhabitants. In northern Germany the pond systems are 10-15 sq m per capita, with a depth of 1.2 m and the surface area distributed among the 3 ponds in a ratio of 3:4:3. In southern Germany the first pond is 0.5-1.0 sq m per capita and <1.5 m deep; the second and third ponds are 5-10 sq m per capita and 1 m deep. Effluent quality of ponds with 10 sq m per capita surface area is as follows: COD, 90 mg/liter; BOD, 25 mg/liter; ammonium-N, 15 mg/liter; phosphate-P, 6 mg/liter. Below a specific pond area of 1.5 sq m per capita effluent qualities are variable. Between 1.5 and 5.0 sq m per capita organic loads are greatly reduced. More than 10 sq m per capita does not produce greater removal of COD and BOD. Stormwater input and organic shock loads are efficiently equalized by the pond systems. The large areas required for lagoon treatment can be reduced by aeration or addition of trickling filters. (Cassar-PTT)
W88-07318

WASTE STABILIZATION PONDS IN FRANCE: AN OVERALL REVIEW,
Div. Qualite des Eaux, CEMAGREF, B. P. 3, F33610 Cestas Principal, France.
P. Boutin, A. Vachon, and Y. Racault.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 25-31, 1987. 6 fig, 1 tab.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Stabilization lagoons, France, Rural areas, Algae, Organic loading, Statistical analysis, Duckweed, Aquatic weeds, Organic loading, Sulfur bacteria.

Results of surveys of about 1,400 waste stabilization ponds in France were statistically analyzed. Not included were industrial plants, polishing ponds, or aerated lagoons. Most of the lagoons were found in rural communities and in the coastal tourist areas. The mean area was 5500 sq m, suitable for processing wastes from 500-600 persons. Ponds ranged in size from 330 sq m to 33 ha. The largest were found on the Mediterranean coast; the smallest, in central France; and intermediate-sized ponds of 0.55 to 1.5 ha, in a strip from Brittany to the Rhone Valley. The three-compartment system is used in many plants, except for the smallest, which use one or two basins. Eighty seven percent of the ponds are 1.0 to 1.2 m deep, 10% are 1.2-1.5 m deep. Anaerobic ponds are rarely used. Macrophytes have been planted in 17% of all ponds, mostly in the northeast. Hydraulic overloading occurs in at least 30% of ponds, whereas organic loading amounts to 10% of ponds, usually industrial effluents. The advantages of the lagoon system have made them very popular among the rural communities. However, some mishaps occur: variation from the designed water depth, duckweed proliferation in summer, and sulfur bacteria in dry summers. Average effluent quality parameters (in mg/liter) are BOD, 23; COD, 100; and suspended solids, 36. (Cassar-PTT)

W88-07319

INITIAL EVALUATION OF AL SUMRA WASTE STABILISATION PONDS (JORDAN),
The Water Authority of Jordan, Amman.
S. S. A. Salem, and J. P. Lumbers.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 33-37, 1987. 1 fig, 5 tab, 1 ref.

Descriptors: *Wastewater treatment, *Water reuse, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, Stabilization lagoons, Jordan, Coliforms, Oxidation lagoons, Organic matter, Biologial oxygen demand, Irrigation, Water reuse.

The Al Sumra waste stabilization system receives 57,000 cu m/day of mainly domestic wastewater from metropolitan Amman. Located 40 km northeast of the city, the ponds cover 181 ha and have a total volume of 2.8 million cu m. Three parallel trains of ponds each consist of two anaerobic ponds, four facultative ponds, and four maturation ponds. Considerable reduction in organic matter takes place during the 39-km pipeline travel time. BOD reduction in the primary anaerobic pond is 43-59% in summer and 6.5-9% in winter. In the facultative pond, BOD reduction is about 18%. Maturation ponds reduces BOD by a further 6%; here pathogens are also destroyed. Effluent standards for coliforms in irrigation water are not met in winter without disinfection. Data on helminth eggs in effluent are not sufficient to form conclusions. In general, the pond system performs satisfactorily for most of the year in producing effluent suitable for irrigation reuse. (Cassar-PTT)
W88-07320

EVALUATION OF WASTE STABILIZATION POND PERFORMANCE IN MISSOURI AND KANSAS, U.S.A.,
Missouri Univ., Columbia. Dept. of Civil Engineering.
S. K. Banerji, and B. Ruess.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 39-46, 1987. 3 fig, 4 tab, 7 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Stabilization lagoons, Missouri, Kansas, Effluent standards, Standards, Performance evaluation, Biological oxygen demand, Suspended solids, Gloyna equation.

Effluent qualities in 20 waste stabilization pond systems were compared with Kansas and Missouri effluent standards. The group consisted of 6 single-cell units, 6 two-cell units, 5 three-cell units, and 3 four-cell units. Many of the systems did not meet standards for BOD and suspended solids. Performance did not correlate well with the traditional design parameters, such as BOD loading rate or mean hydraulic detention time. The use of multiple cells did not necessarily improve effluent quality. Gloyna's equation for determining the pond volume to produce a 80-90% removal efficiency was not very accurate in predicting the pond performance. Use of the plug flow equation for evaluation of pond performance was unsuitable because the calculated BOD removal coefficient was quite variable. To remove excess suspended solids, especially in the critical summer months, an aquatic marsh system or land application of effluents may be considered. (Cassar-PTT)
W88-07321

WASTEWATER LAGOONS IN A COLD CLIMATE,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
J. A. Oleszkiewicz, and A. B. Sparling.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 47-53, 1987. 5 fig, 1 tab, 2 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Organic loading, *Biological wastewater treatment, *Anaerobic lagoons, *Cold regions, *Odor control, Stabilization lagoons, Manitoba, Ice breakup, Aeration, Oxidation, Hydrogen sulfide, Design criteria, Biological oxygen demand, Algal growth, Dissolved oxygen, Performance evaluation, Hydrogen ion concentration.

Lagoons remain a cost-effective method of wastewater treatment in Manitoba in spite of the severely cold climate. Design criteria presently used are a maximum load of 55 kg BOD/ha day to the first cell of a facultative lagoon system with 196 days retention time. An odor nuisance occurring during spring ice breakup can be managed by limiting organic loads to 35 kg/ha. Under-the-ice aeration is expensive and ineffective in odor control. The normal odor control mechanism operates in the following manner. The first algal blooms occur in March or early April, driving the dissolved oxygen beyond saturation and increasing pH. This causes sulfides to precipitate and other reduced products to oxidize. However, if BOD loads exceed the capacity of the system to oxidize, odors result. Odors are particularly bad in lagoons receiving significant organic input from the agricultural industry. Many municipalities with these systems have been refitted with a highly loaded continuous flow aerated lagoon preceding the two facultative cells in series. (Cassar-PTT)
W88-07322

DEVELOPMENT OF LAGOONS IN VENEZUELA,
Mark Lansdell y Asociados, Apartado 17156, Caracas, Venezuela.
M. Lansdell.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 55-60, 1987. 3 fig, 1 tab, 3 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Designs, *Biological wastewater treatment, *Anaerobic lagoons, Venezuela, Stabilization lagoons, Monitoring, Odors, Insects, Washouts, Water loss.

Seven lagoon systems built in Venezuela in 1969-1973 experienced several problems: vegetation overgrowth, insect breeding, evaporation loss, flood washout, overloading, and odor problems. A new generation of lagoons, designed for populations up to 1 million, were designed to avoid the no-fill situation and to control vegetation. However, plants sprouted from the expansion joints in the concrete linings and from the disintegrated asphalt linings. The anaerobic reactor system has been more successful. One designed for a village of 1,000 persons consists of two baffled concrete tanks in parallel with a roof consisting of aluminum mosquito netting stretched over wood frames. The tanks have hopper bottoms with valved sludge drawoff pipes. The final effluent weir has two V-notches, one for discharge to a sea outfall and the other angled to recirculate 50% of the flow. The recirculation allows formation of a green photosynthetic layer on the anaerobic reactor, reducing odors. A second type of system, designed for 10,00 people, has a five-compartment anaerobic reactor in series with upward flow. The final pond has a hopper bottom and valved sludge draw-off pipe to an adjacent drying bed. Effluent quality monitoring has shown no parasitic eggs or cysts in 25 samples collected; the systems are capable of meeting Engleberg requirements for irrigation water quality. Two systems capable of treating wastes from 1 million people are under construction. These follow the anaerobic reactor principle and will incorporate effluent and sludge recycling. (Cassar-PTT)
W88-07323

PERFORMANCE OF A SERIES OF FIVE DEEP WASTE STABILIZATION PONDS IN NORTHEAST BRAZIL,
EXTRABES, Universidade Federal da Paraiba, Caixa Postal 306, 58.100 Campina Grande, Brazil.
S. A. Silva, D. D. Mara, and R. de Oliveira.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 61-64, 1987. 1 fig, 2 tab, 8 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, Performance evaluation, Brazil, Stabilization lagoons, Pathogens, Parasites, Pilot plants, Biochemical oxygen demand, Suspended solids, Chemical oxygen demand, Fecal coliforms, Invertebrates, Ammonia, Phosphorus.

A pilot-scale waste stabilization pond system was built at a wastewater treatment experimental station. It consisted of an anaerobic pond, a secondary facultative pond, and three maturation ponds. The overall mean hydraulic retention time was 25 days; the dimensions of each pond, 10.00 x 3.35 x 2.2 meters. Removal was 88% of BOD, 69% of COD, 83% of suspended solids, 4% of ammonia, 6% of total phosphorus, 99.97% of fecal coliforms, 100% of Ascaris and Trichuris, and 94% of hookworms. (Cassar-PTT)
W88-07324

USE OF AN ALGAL-MICROCRUSTACEAN POLYCULTURE SYSTEM FOR DOMESTIC WASTEWATER TREATMENT,
Research Department, CETESB (Sao Paulo Environmental Protection Agency). Av. Prof. Frederico Hermann Junior, 345, 05459, Sao Paulo-SP, Brazil.
H. Kawai, P. Jureidini, J. Conceicao Neto, O. F. Motter, and R. Rossetto.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 65-70, 1987. 3 fig, 2 tab, 5 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, *Aquaculture, Algae, Crustaceans, Daphnia, Zooplankton, Animal feed, Polyculture, Stabilization lagoons, Biological oxygen demand, Nitrogen, Phosphorus.

Domestic wastes were treated in a polyculture system consisting of an anaerobic pond, an algae pond, and zooplankton pond with the goal of using the zooplankton as animal feed. Scenedesmus sp. and Daphnia sp. were introduced into the algal and zooplankton ponds, respectively. The best operational performance was obtained when the zooplankton pond was operated with a semicontinuous flow system, with 50% of the zooplankton pond water being renewed with effluent from the algae pond every 2 or 3 days. Under these conditions, Daphnia productivity reached 35 mg/liter (dry weight), corresponding to 700 kg per day produced from wastes of a city of 100,000 inhabitants. Removal efficiencies were BOD, 95-97%; total N, 42-59%; and total P, 37-48%. Algal removal in the zooplankton pond was 99.99% efficient. (Cassar-PTT)
W88-07325

CHEMICAL PRECIPITATION IN HIGHLY LOADED STABILIZATION PONDS IN COLD CLIMATES: SCANDINAVIAN EXPERIENCES,
The Norwegian Institute of Technology, N-7034 Trondheim, Norway.
H. Odegaard, P. Balmer, and J. Hanaeus.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 71-77, 1987. 4 fig, 5 tab, 4 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Cold regions, *Chemical precipitation, *Design criteria, Stabilization lagoons, Scandinavia, Aeration, Phosphorus removal, Organic loading, Pilot plants, Cost analysis, Biological oxygen demand, Organic matter, Odors.

Pilot-plant and full-scale studies of stabilization ponds operating with phosphate precipitation showed that these systems are cheap and effective for use in small communities and tourist areas. In-pond precipitation is simpler and cheaper than pre- or post-pond precipitation. BOD reduction is 70-90%, and total phosphorus reduction is 85-95%. Chemical precipitation is more important than biodegradation in the removal of organic matter. Therefore, the ponds may be heavily loaded. The design load depends on the acceptable frequency of desludging and acceptable odor emission. In very highly loaded systems (<6 days residence time, <3 sq m/population equivalent) and high-load systems (<30 days, <10 sq m/population equivalent) chemicals should be added in proportion to the flow at the inlet of the first pond in the two or three pond system. The first pond should be deeper (1.7-2.0 m) than the others to accommodate sludge storage. In moderately loaded systems (30-60 days residence time, 10-20 sq m/population

equivalent) precipitant can be dosed to the inlet of the second pond. Odor produced by the high loading can be reduced by aerating the effluent of each pond. (Cassar-PTT)
W88-07326

POND TREATMENT OF RETTERY WASTEWATERS,
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
K. Bartoszewsi, and A. Bilyk.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 79-83, 1987. 1 fig, 4 tab, 3 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, *Industrial wastes, *Textile mill wastes, Stabilization lagoons, Activated sludge process, Rettery wastewater, Flax processing, Hemp processing, Performance evaluation, Chemical oxygen demand, Biological oxygen demand.

An obsolete plant for treatment of rettery wastes (flax and hemp) was redesigned, substituting aeration and stabilization ponds for the anaerobic ponds, which yielded BOD and COD removal as low as 20%. It was proposed that aerobic treatment be carried out in three ponds connected in series, with stabilization occurring in the remaining four ponds. The first of the four stabilization ponds would act as a settling tank; the remaining ponds would act as facultative ponds. Total volume for the aerobic ponds was designated as 2900 cu m; optimal retention time, about 9 days; sedimentation and stabilization, 12 days; oxygen demand, 455-500 kg per day; power demand, 9-12 W/cu m. Average effluent BOD and COD were calculated as 20 and 275 g oxygen per cu m, respectively, with removal efficiency in winter half that for summer. The design specified that activated sludge be stabilized aerobically for 16 to 24 days, followed by drying in the open. (Cassar-PTT)
W88-07327

TREATMENT OF SLAUGHTERHOUSE WASTEWATERS IN STABILIZATION PONDS,
Aveiro Univ. (Portugal).
A. C. Duarte, L. M. Arroja, P. F. Diegues, I. Rosada, and A. Hall.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 85-91, 1987. 5 fig, 4 tab, 2 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Industrial wastewater, *Meat processing industry, *Anaerobic lagoons, Stabilization lagoons, Biological oxygen demand, Chemical oxygen demand, Suspended solids, Organic loading.

Effluent quality was studied in a pond treatment system for processing slaughterhouse wastes from 625 pigs per week. The system consisted of one anaerobic (10 x 10 x 3.5 m), one facultative (78 x 26 x 1 m), and two maturation ponds (33 x 11 x 1 m each) in series. Mean values for raw wastewater (in mg/liter) were BOD, 1308; COD, 1905; soluble COD, 1147; and suspended solids, 395. Effluent values (in mg/liter) and percent removal were as follows: BOD, 101 (92%); COD, 269 (85%); soluble COD, 183.5 (85%); and suspended solids, 69.7 (81%). In spite of poor maintenance, allowing macrophyte growth and bank erosion, and large variations in flow and organic load, impact on the receiving creek was minimal. (Cassar-PTT)
W88-07328

WATER QUALITY IMPROVEMENT OF SECONDARY EFFLUENT BY AN OXIDATION POND WITH SUBSEQUENT SAND FILTRATION TREATMENT,
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
S. Fujii, I. Somiya, and K. Takeda.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 93-9, 1987. 5 fig, 5 tab, 4 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Tertiary wastewater treatment, *Oxidation ponds, *Filtration, Nutrient removal, Algae, Stabilization lagoons, Nitrogen removal, Phosphorus removal, Fish.

Secondary effluent was treated in an oxidation pond followed by sand filtration to remove organics and nutrients. The main reaction mechanism in the oxidation pond was fixation of inorganic nutrients by algae. Total N and total P in the pond effluent were decreased by 80% and 77%, respectively, because of sedimentation of the particulate fraction. Sand filtration at a rate >5 m/day clogged the sand filter within 1-3 days. However, at a rate of <1 m/day, decomposition of the filter deposits occurred, allowing a run length of >20 days. Removal efficiency of suspended solids was 97-100%. Treatment with oxidation pond plus sand filtration produced 24-37% removal of N and 32-75% removal of P. The optimum filtration rate was 0.5 m/day. The presence of fish (Rhinogobius brunneus) extended the run length by 20% or more because of feeding on the filter deposits. (Cassar-PTT)
W88-07329

REMOVAL OF ORGANICS FROM LEACHATE BY THE COMBINED PROCESS OF A FACULTATIVE PRE-TREATMENT POND AND AN AERATED LAGOON AT A SEA-BASED SOLID WASTE DISPOSAL SITE,
Osaka City Inst. of Public Health and Environmental Sciences (Japan).
K. Takamizawa, O. Yamamoto, I. Fukunage, Z. Inoue, and A. Honda.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 101-107, 1987. 8 fig, 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Water pollution control, *Biological wastewater treatment, *Leachate, Organic matter, Aeration, Manganese, Landfills, Waste disposal, Osaka, Japan, Aeration, Stabilization lagoons, Biological oxygen demand, Chemical oxygen demand, Manganese.

Leachate was collected from the sea-based North Port Solid Waste Disposal Site, Osaka City, and a bench-scale treatment of the combined process of a facultative pre-treatment pond and an aerated lagoon was applied for more than 120 days. The maximum BOD removal rate coefficient and COD-manganese removal rate coefficient were 0.090/day and 0.018/day, respectively. These values were obtained when the retention time of the facultative pre-treatment pond was 25 days. But, if the retention time was beyond or below 25 days, both removal rate coefficients were smaller. Therefore, it was concluded that the optimum retention time of a facultative pre-treatment pond was 25 days. This was reconfirmed by the gel-permeation chromatography of the treated leachate, a method for evaluating wastewater treatability proposed by Tambo and Kamei in 1978. Furthermore, the gel-permeation chromatography pattern of the treated leachate in the bench-scale experiment coincided with that obtained by the actual field test. In addition, it was concluded that higher-molecular organics were decomposed biologically into lower-molecular organics at the middle and bottom layers of the facultative pre-treatment pond. BOD and COD-manganese values of below 10 mg/liter and about 130 mg/liter, respectively, appeared to be the maximum effective level of the combined process. (Author's abstract)
W88-07330

WATER COLUMN SAMPLING AS A RAPID AND EFFICIENT METHOD OF DETERMINING EFFLUENT QUALITY AND THE PERFORMANCE OF WASTE STABILIZATION PONDS,
Liverpool Univ. (England). Dept. of Botany.
H. W. Pearson, D. D. Mara, A. Konig, R. de Oliveira, and S. W. Mills.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 109-113, 1987. 1 fig, 3 tab, 8 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Sampling, Effluents, Performance evaluation, Stabilization lagoons, Algae, Coliforms, Chlorophyll, Suspended solids, Ammonia.

Diurnal series of samples of the effluent and the total in-pond water column of facultative and maturation ponds were analyzed for COD, suspended solids, fecal coliforms, chlorophyll, and ammonia with a view to finding the most efficient way of obtaining reliable mean daily effluent quality data. The results show that individual samples representative of the entire depth of the pond water column taken at any time of day provided reasonably accurate mean daily effluent values for all the parameters measured when compared with the mean values for effluent quality calculated from a series of grab effluent samples collected throughout the day. The same could not be said for the individual grab effluent samples since they varied considerably. It was not recommended that daily and weekly composite sampling be discontinued at plants with resources to collect and analyze the samples. However, this protocol may be satisfactory for limited monitoring programs in which many stabilization pond complexes throughout a region are sampled by a mobile team. (Cassar-PTT)
W88-07331

AMMONIA TOXICITY TO ALGAL GROWTH IN WASTE STABILIZATION PONDS,
Universidade Federal da Paraiba, Campina Grande (Brazil).
A. Konig, H. W. Pearson, and S. A. Silva.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 115-122, 1987. 4 fig, 2 tab, 20 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Ammonia, *Toxicity, *Algae, Brazil, Stabilization lagoons, Hydrogen ion concentration, Chlorella, Euglena, Biological oxygen demand, Ammonium.

The ammonia concentrations in 1.25 and 2.3 meter deep waste stabilization ponds at Extrabes, Brazil receiving domestic sewage were largely independent of the surface organic loadings on the deep ponds at least above loading rates of 200 kg BOD/ha/day, but varied with time between 14 and 29 mg/liter NH3-N. During daylight, pH values reached about 9.0 (sometimes higher) in the surface water layers as a result of algal photosynthesis. Laboratory growth studies showed that a pond isolate of Chlorella was more tolerant to ammonia than the Euglena species and grew in media containing 10 mM ammonia at a pH of 9.0 and a temperature of 25 C when 40% of the total ammonia concentration was in the toxic unionized NH3 form. This tolerance would appear to be inherent since the Chlorella was isolated from ponds containing ammonia concentrations of 1-3 mM and was subsequently maintained routinely in the laboratory at such ammonia levels. (Author's abstract)
W88-07332

NITROGEN TRANSFORMATIONS AND REMOVAL IN WASTE STABILIZATION PONDS IN PORTUGAL: SEASONAL VARIATIONS,
Dept. of Environmental Engineering, Faculdade de Ciencias e Tecnologia, Universidade Nova de Lisboa, Quinta de Torre, 2825, Monte de Caparica, Portugal.
M. C. R. Santos, and J. F. S. Oliveira.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 123-130, 1987. 9 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Nitrification, *Anaerobic lagoons, *Nitrogen, *Seasonal variation, Nitrates, Nitrites, Ammonia, Water temperature, Temperature, Portugal, Stabilization lagoons, Mineralization, Sedimentation.

Nitrogen transformations were studied in a domestic wastewater treatment system consisting of three ponds in series: anaerobic, facultative, and maturation. The anaerobic pond was an important site of organic nitrogen removal, mainly by mineralization, accompanied by some sedimentation. Ammonia removal was larger in the facultative pond because of assimilation by bacteria and algae and subsequent nitrification to nitrite and nitrate. Nitrification also occurred in the maturation pond. However, denitrification was not demonstrated.

Seasonal variations in nitrogen transformation were observed. Generally, removal and bioconversion was greater in summer and smaller in winter because of the effect of water temperature on biological processes. Dilution of effluent by rainfall during autumn and winter increased the removal and masked the effect of the lower temperatures. Of all the types of nitrogen transformation, soluble organic nitrogen mineralization was least influenced by temperature in the anaerobic pond. Nitrite accumulated in the maturation pond during winter and spring and was oxidized to nitrate in summer and autumn. Nitrite increased in the anaerobic pond during summer, possibly a consequence of ammonia oxidation in the surface layers. Nitrate concentrations in facultative pond and maturation pond effluents significantly increased in summer and were correlated with air temperature. (Cassar-PTT)
W88-07333

FACTORS DETERMINING ALGAL POPULATIONS IN WASTE STABILIZATION PONDS AND THE INFLUENCE OF ALGAE ON POND PERFORMANCE,
Liverpool Univ. (England). Dept. of Botany.
H. W. Pearson, D. D. Mara, S. W. Mills, and D. J. Smallman.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 131-140, 1987. 4 fig, 6 tab, 19 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Algae, Toxicity, Ammonia, Sulfides, Population dynamics, Stabilization lagoons, Performance evaluation, Organic wastes.

In situ and laboratory experiments were performed on species of the waste stabilization pond algae Chlorella, Scenedesmus, Euglena, and Chlamydomonas to investigate the utilization of various organic acids and sugars and light limitation on species dominance and the toxicity of ammonia and sulfide. Euglena showed the most flexible metabolism and was able to utilize butyrate. Scenedesmus did not grow on any of the substrates in the dark. Pond populations of Euglena and Chlamydomonas were able to incorporate acetate in situ in competition with the heterotrophic bacterial population but Chlamydomonas was the more successful. Light availability affected speciation in facultative ponds where rapid motility by flagellates was a clear advantage. All the algal species were sensitive to sulfide. Total sulfide concentrations (in microM) causing 50% growth inhibition at pH 7.25 were Euglena, 27.5; Scenedesmus, 58.3; Chlorella, 80.0; and Chlamydomonas, 118.3. The undissociated forms of sulfide and of ammonia were responsible for the toxicity. Several conclusions were reached. The appearance of a surface film of Chlamydomonas on anaerobic ponds does not affect pond performance. Chlamydomonas on a facultative pond may indicate overloading, reduced oxygen generation, and a consequent reduction in performance. (Cassar-PTT)
W88-07334

MICROORGANISM REMOVAL IN WASTE STABILIZATION PONDS IN PORTUGAL,
Centro de Investigacao do Ambiente, Direccao-Geral da Qualidade do Ambiente, Lisboa, Av. Gago Coutinho, 30 - 1000 Lisboa, Portugal.
M. J. do Nascimento.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 141-144, 1987. 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, *Bacteria, Biological indicators, Indicators, Coliforms, Portugal, Stabilization lagoons, Pseudomonas aeruginosa, Clostridium perfringens, Microbiological studies, Performance evaluation, Water reuse, Retention time, Hydraulics.

Effluent from a waste stabilization pond system at Frielas, near Lisbon, Portugal, was subjected to microbiological study to evaluate pond performance. Organisms monitored were fecal coliforms, fecal streptococci, total heterotrophic bacteria, Pseudomonas aeruginosa, and Clostridium perfringens. Details of the pond construction were not given. Effluent from the classic system (anaerobic, facultative, and maturation ponds) did not meet requirements for irrigation (fecal coliforms of <1000 per ml for restricted use). Addition of another maturation pond would probably produce effluent of acceptable quality. Another similar system produced effluent of acceptable reuse quality. The removal efficiency for all but one of the indicator organisms was 10/100 ml in the anaerobic pond in one system and less in the other. In facultative ponds the removal was 10/100 ml. In one maturation pond the removal efficiency was higher for traditional indicators (fecal coliforms and streptococci) than for the experimental indicators (Pseudomonas and Clostridium). In the other maturation pond removal was less. It was concluded that effluent quality depended on retention time and hydraulic patterns. (Cassar-PTT)
W88-07335

PHYSICO-CHEMICAL PARAMETERS INFLUENCING FAECAL BACTERIAL SURVIVAL IN WASTE STABILIZATION PONDS,
Liverpool Univ. (England). Dept. of Botany.
H. W. Pearson, D. D. Mara, S. W. Mills, and D. J. Smallman.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 145-152, 1987. 3 fig, 4 tab, 21 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Bacteria, Portugal, Coliforms, Sewage bacteria, Hydrogen ion concentration, Water temperature, Temperature, Dissolved oxygen, Algae, Light intensity, Daphnia, Stabilization lagoons.

In situ studies on waste stabilization ponds in Portugal showed that fecal coliform numbers were lowest at positions in the water column where pH, temperature, dissolved oxygen, and algae were high. Numbers were not always lowest at the surface where light intensities were highest or in ponds where light penetration had increased through algal grazing by Daphnia. Laboratory studies showed that pH values approaching 9.0 or above increased fecal coliform die-off particularly under nutrient-poor conditions. Elevated temperatures enhanced the pH effect, but the level of dissolved oxygen made little difference. Streptococcus, Salmonella, and Campylobacter isolates all behaved similarly to the fecal coliforms. Daphnia grazing of the algal population in maturation ponds may reduce the microbial quality of the final effluent. (Author's abstract)
W88-07336

SEDIMENTATION AND DIGESTION ON POND BOTTOMS--AN ATTEMPT TO ESTABLISH A SHORT-TERM MATERIAL BALANCE,
Ecole Nationale de la Sante Publique, Rennes (France). Lab. de Genie Sanitaire.
A. Iwema, J. Carre, and D. Minot.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 153-159, 1987. 3 fig, 8 tab, 14 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Sedimentation, *Digestion, Stabilization lagoons, Bottom sediments, Methanogenesis, Seasonal variation.

Sedimentation and digestion were measured in situ on the bottom of the first (facultative) and the last (maturation) pond of a wastewater stabilization pond system during the period from the end of May until the beginning of July. Calculated dry solids balances of the pond bottoms showed that most of the collected solids were probably of endogenous origin. It was concluded that the collected solids were fairly stabilized bottom sediments which were resuspended by vigorous gas production in the warmer seasons. The net transport of solids was impossible to obtain. (Cassar-PTT)
W88-07337

SIMULATION OF BENTHAL STABILIZATION,
Arizona Univ., Tucson.
C. W. Bryant, and E. C. Bauer.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 161-167, 1987. 1 fig, 5 tab, 23 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Benthos, Nutrients, Nitrogen, Phosphorus, Stabilization lagoons, Sedimentation, Bottom sediments, Pulp and paper industry, Pulp wastes, Industrial wastes, Model studies, Feedback.

An existing model was modified and calibrated to describe the physical and biological processes in consolidating organic deposits of municipal and paper mill wastes in an aerated stabilization pond. Modifications consisted of the addition of temperature sensitivity, phosphorus reactions, and the flexibility as to solids identification. Comparison with laboratory and field data showed good prediction of phosphorus uptake; nitrogen feedback trends and some carbon feedback trends at 15C and 25C were not well simulated by the model. (Cassar-PTT)
W88-07338

EFFECTS OF MATURATION ON THE CHARACTERISTICS OF WASTEWATER STABILIZATION POND SLUDGES,
Ecole Nationale de la Sante Publique, Rennes (France). Lab. de Genie Sanitaire.
J. Carre, and D. Barron.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 169-175, 1987. 3 fig, 1 tab, 20 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Sludge, *Anaerobic lagoons, *Bacteria, *Sludge maturation, Nitrogen, Phosphorus, Indicators, Salmonella, Fecal coliforms, Coliforms, Streptococci, Bottom sediments, Stabilization lagoons, Organic matter, Sulfides, Hydrogen ion concentration, Phosphates.

Sludge from wastewater stabilization ponds was studied in two vertical profiles (near inlet and near outlet) to characterize the effects of the maturation of the sludge. Ten years of storage resulted in a significant increase in sludge density and in an enhanced degradation of the organic matter. The organic degradation was accompanied by the regeneration of 80% of total organic carbon, 70% of particulate Kjeldahl nitrogen, and 75% of total phosphorus. Phosphorus was rapidly mineralized and appeared in the dissolved state only in the young sludge. Ammonia dissolved in the interstitial phase increased in concentration with depth and thus with the age of the sludge. Sludge near the inlet was more mineralized and had larger particle size than sludge near the outlet. Bacterial contamination was greater (by about one log) near the inlet than near the outlet, except for the spores of the sulfate-reducing clostridia. Sludge maturation resulted in decreased concentrations with depth, except for the spores of clostridia, for the entire profile near the outlet, but for only the upper 40 cm of the profile near the inlet; below 40 cm concentrations increased. This was explained by fragmentation of particulate matter on which bacterial were absorbed. Salmonella concentrations were random and low; no concentration gradient was established. Maturation had little effect on concentrations of fecal indicator organisms, other than clostridia; decreases did not exceed log 4. (Cassar-PTT)
W88-07339

IDENTIFICATION OF BENTHIC FEED-BACK IN FACULTATIVE PONDS,
Process Modelling and Control Research Group, Department of Civil Engineering, Imperial College, London SW7 2BU, United Kingdom.
J. P. Lumbers, and R. Y. G. Andoh.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 177-182, 1987. 8 fig, 3 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Design criteria, *Feedback, *Biological wastewater treatment, Model studies, Organic matter, Bottom sediments, Stabilization lagoons, Sludge, Odor control, Design criteria.

An identification study of the feed-back of soluble organic matter from the benthic sludge in facultative ponds was based on field data gathered in a New Mexico pond system. The study used recursive estimation techniques to help identify the appropriate model structures. Model development progressed from the analysis of a simple nonreactive system to one incorporating two subsystems; the planktonic region and the benthic region. The inclusion of a temperature-related feed-back term produced good model results, while the temperature-corrected decay rate constant remained constant over time. The magnitude of the feed-back term appeared to be equal to the incoming load in the hottest months of the year. The practice of designing ponds for the coldest month was not compatible with other objectives. In the coldest season, pathogen removal was shown to be the limiting factor, unrelated to BOD loading. In the warm season, odor control was shown to be of concern. (Cassar-PTT)
W88-07340

ATTENUATION OF UNDERGROUND WATER CONTAMINATION IN A VINASSE CLAY-LINED POND,
Dept. of Chemical Engineering, Sao Paulo University, P.O. Box 8178, Sao Paulo, SP, 01000, Brazil.
P. M. Buchler.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 183-185, 1987. 2 fig, 10 ref.

Descriptors: *Organic loading, *Wastewater treatment, *Water quality control, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Stabilization lagoons, Vinasse, Organic matter, Bentonite, Clay, Linings, Water pollution prevention, Sugarcane, Industrial wastes, Bottom sediments, Sediments, Adsorption, Simulation.

Clay liners for stabilization ponds were studied to determine their effectiveness in adsorbing and serving as a barrier to vinasse, the liquid residue from sugar cane alcohol distillation. The organic content of this residue is 50,000 mg/liter. The tetramethylammonium derivative of a Brazilian sodium bentonite and of a Wyoming clay were mixed with solutions of vinasse and its organic components: phenol, fructose, glycerol, ethanol, glucose, dextran. Adsorption isotherms showed that vinasse was the substance most highly absorbed, followed by phenol and the other components. The Wyoming clay was more effective because of its lower content of the clay mineral, smectite. A computer simulation showed that the clay liner could be replaced once a year during the months the distillery is not in operation. (Cassar-PTT)
W88-07341

DESIGN EQUATIONS FOR BOD REMOVAL IN FACULTATIVE PONDS,
Tennessee Technological Univ., Cookeville.
E. J. Middlebrooks.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 187-193, 1987. 8 fig, 2 tab, 9 ref.

Descriptors: *Biochemical oxygen demand, *Wastewater treatment, *Stabilization ponds, *Ponds, *Design criteria, *Biological wastewater treatment, Model studies, Mathematical models, Organic matter, Stabilization lagoons, Plug flow model, Complete mixing model.

Facultative pond performance data collected for the EPA at four locations (New Hampshire, Mississippi, Kansas, and Utah) and data from other investigations were used to evaluate the most frequently used design equations and to develop nonlinear design equations. Empirical models were evaluated as well as the classical plug flow and complete mix models. The first-order plug flow model gave the best fit of all the rational models. The empirical nonlinear models did not fit the data, nor did the other empirical models, with the exception of the areal loading and removal model. Attempts to verify the models developed with EPA data using data collected by others were not successful with the exception of the areal loading and removal model. (Cassar-PTT)
W88-07342

INTERPRETATION OF LABORATORY-SCALE WASTE STABILIZATION POND STUDIES,
Sydney Univ. (Australia). Dept. of Chemical Engineering.
T. Wood.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 195-203, 1987. 3 fig, 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Wastewater loading, *Model studies, Mathematical models, Design criteria, Mixing, Stabilization lagoons, Kinetics, Hydraulic models.

The importance of choosing an appropriate mathematical model for analysis of data from laboratory-scale studies of waste stabilization ponds was demonstrated. Two case studies were presented. Both used semicontinuous methods of experimentation involving the addition of discrete volumes of feed at regular intervals. Mathematical models of continuous processes to analyze were used the results. Use of semicontinuous models in both studies produced significant differences in interpretation of data. In the first case study it was related to the determination of rate constants; in the second case study, to the determination of an appropriate model to describe hydraulic mixing. (Cassar-PTT)
W88-07343

WASTE STABILIZATION POND PREDICTION MODEL,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
H. C. Preul, and R. A. Wagner.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 205-211, 1987. 3 fig, 5 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Design criteria, *Model studies, Mathematical models, Computer models, Organic loading, Mixing, Thermal stratification, Stratification, Stabilization lagoons, Climate.

A prediction model for calculating the expected effluent performance of a facultative waste stabilization pond is presented. The model is intended to improve on current design approaches through more appropriate recognition of physical and climatic factors which affect the prediction of pond performance. The importance of hydraulic routing through a pond is stressed along with wind mixing, thermal stratification, pond geometry, and other basic design parameters. The final form of the model is a working equation based on analyses of the various pond processes. Because of the complexity of the final analytical model, it must be applied using computerized methods. (Author's abstract)
W88-07344

ALTERNATIVE APPROACH TO THE DESIGN OF WASTE STABILIZATION PONDS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 213-218, 1987. 1 fig, 2 tab, 20 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Organic matter, *Pathogens, *Ponds, *Biological wastewater treatment, *Anaerobic lagoons, *Bacteria, Algae, Design criteria, Mixing, Stabilization lagoons, Light, Methane.

An alternative approach to design of waste stabilization ponds is suggested that emphasizes organic removal by methane production followed by light-induced die-off of pathogens in an algal-free aerobic pond. Common problems in efficiency of pathogen removal are related to short-circuiting in mixing, complete mixing (allows algal growth), and the presence of organic matter (favors bacterial growth). Important facts to consider are (1) Light plays little part in increasing the bacterial death rate. (2) Die-off rates in ponds are generally lower than those obtained in fresh or saline waters in the dark. (3) Algae are undesirable. (4) The most successful mechanism of BOD removal is conversion to methane in anaerobic ponds. The land area designated by this method is 60-70% smaller than that obtained by a conventional design method. (Cassar-PTT)
W88-07345

HYDRAULIC PERFORMANCE OF WASTE STABILIZATION PONDS IN PORTUGAL,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
M. H. F. Marecos do Monte, and D. D. Mara.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 219-227, 1987. 8 fig, 4 tab, 8 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Design criteria, Model studies, Mathematical models, Hydraulic properties, Portugal, Tracer studies, Stabilization lagoons, Performance evaluation.

The hydraulic regimes in two Portuguese facultative waste stabilization ponds were studied with a fluorescent dye tracer technique. One pond was a primary facultative pond receiving raw sewage (Portimao); the second was a secondary pond receiving the effluent from an anaerobic pond (Vidigueira). The dispersion numbers were as follows; Portimao--0.595 in winter and 0.371 in summer; Vidigueira--0.574 in winter and 0.523 in summer. Results did not agree with those obtained from the available predictive equations in the recent literature. (Cassar-PTT)
W88-07346

ATTACHED-GROWTH WASTE STABILIZATION POND TREATMENT EVALUATION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
H. K. Shin, and C. Polprasert.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 229-235, 1987. 3 fig, 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Performance evaluation, Stabilization lagoons, Biofilm, Kinetics, Model studies, Organic loading, Biomass, Coliforms, Bacteria, Feasibility studies, Pilot plants, Polyvinlidene chloride.

This study investigated the feasibility of improving waste stabilization ponds performance through the addition of attached-growth media in the pond water. An artificial media consisting of fine strings of polyvinylidene chloride was employed as an attached-growth media in the laboratory-scale and pilot-scale experiments. Better removal of organic, nutrient and suspended solids were obtained in the attached-growth waste stabilization ponds. The attached-growth ponds were found to be rather stable against increased hydraulic loadings. However, the fecal coliform die-off in the attached-growth units was not significantly different from that of the control units without attached-growth media. (Author's abstract)
W88-07347

STUDY OF THE PERFORMANCE OF A HIGH-RATE PHOTOSYNTHETIC POND SYSTEM,
Laboratorio de Engenharia Bioquimica, Instituto Superior Tecnico, Av. Rovisco Pais, 1096 Lisboa Codex, Portugal.
H. M. Pinheiro, M. T. Reis, and J. M. Novais.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 237-241, 1987. 2 fig, 1 tab, 2 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Color, *Photosynthetic ponds, Algae, Portugal, Sulfur bacteria, Bacteria, Performance evaluation, Stabilization lagoons, Sludge, Saline water, Photosynthesis.

Color changes (intense green, pink, gray-brown) and other marked disturbances were observed at a high-rate photosynthetic pond system at Alcochete, Portugal. Previous chemical and microbiological tests made it possible to attribute these occurrences to the proliferation of purple sulfur bacteria, following the probable production of sul-

fide in the ponds by sulfate-reducing bacteria. Results from more recent tests and observations confirmed the earlier conclusions and revealed inadequacies in the operating conditions. Corrective actions include a more efficient mixing of pond contents, prevention of contamination by salty estuarine waters, and control of residence times and bottom sludge accumulation. (Cassar-PTT)
W88-07348

HIGH-RATE ALGAL PONDS; TREATMENT OF WASTEWATERS AND PROTEIN PRODUCTION: IV. CHEMICAL COMPOSITION OF BIOMASS PRODUCED FROM SWINE WASTES,
Departmento de Ciencias e Engenharia do Ambiente, Faculdade de Ciencias e Tecnologia, U. N. L., Quinta da Torre, 2825 Monte da Caparica, Portugal.
A. M. Rodrigues, and J. F. Santos Oliveira.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 243-248, 1987. 2 fig, 3 tab, 27 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Algae, *Animal wastes, Animal feed, Protein, Biomass, Hogs, Stabilization lagoons, Pilot plants, Nutrients.

Swine wastes from swine breeding installations were treated in a pilot system of high rate algal ponds. The Albazod biomass (designates total particulate matter in high-rate algal ponds) was determined in order to evaluate the potential of Albazod for utilization as a protein supplement to animal feed. The most important component in the Albazod biomass was crude protein, which increased when detention time decreased. For a three-day detention time the following nutrient materials were obtained (percent dry weight): crude protein, 41.46%; carbohydrates, 29.80%; fats, 4.93%. Ash amounted to 23.81%. (Cassar-PTT)
W88-07349

HIGH-RATE OXIDATION PONDS: THE ISRAELI EXPERIENCE,
Environmental and Water Resources Engineering, Technion, Haifa 32000, Israel.
G. Shelef, and Y. Azov.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 249-255, 1987. 8 fig, 1 tab, 19 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Fish farming, *Biological wastewater treatment, *Oxidation ponds, Israel, Algae, Stabilization lagoons, Seasonal variation, Pilot plants, Temperature, Solar radiation.

High-rate oxidation ponds for wastewater treatment and algal biomass production have been extensively studied in Israel. Research has been conducted at all scales, including laboratory, outdoor miniponds, pilot- plant, field-scale, and a full-scale. Systems must be designed to suit the environmental and climatic constraints of a specific location. Ponds in a tropical location can use a constant retention time. Operation must also be designed to account for seasonal variations in solar radiation and temperature. This may be done by operating deeper ponds (at longer retention time) during the cold season and using idle ponds in summer for commercial fish raising. (Cassar-PTT)
W88-07350

HARVESTING OF ALGAE FROM HIGH-RATE PONDS BY FLOCCULATION-FLOTATION,
Environmental and Water Resources Research Center, Technion, Israel Institute of Technology, Haifa 32000, Israel.
E. Sandbank, and G. Shelef.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 257-263, 1987. 6 fig, 1 tab, 20 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Algae, *Flocculation, *Flotation, Dissolved air flotation, Electroflotation, Stabilization lagoons, Aluminum sulfate.

Microalgae grown in stabilization ponds and in high-rate oxidation ponds treating wastewater were harvested by flocculation with aluminum sulfate and floated in a laboratory electroflotation unit, where bubbles were produced electrolytically. It was shown that the higher the solids concentration, the lower was the air-to-solids ratio needed to achieve 90% algal removal. The simultaneous flocculation of suspended algae and release of bubbles while flocs grew gave equivalent suspended solids removal when compared with the classical flush mixing flocculation followed by slow mixing-flotation stage. Air-to-solids ratios between 0.009 and 0.013 were sufficient for flocs flotation by dissolved air flotation and electroflotation. Continuous flocculation-flotation in a dissolved air flotation pilot plant unit showed that flush mixing can be replaced by injection of chemicals in-line, provided a retention of 15 sec is given before the inflow to the flotation tank. Slow mixing could be eliminated altogether when bubbles were generated simultaneously with the flocculation stage. Dissolved air flotation was further simplified, replacing the air compressor used for pressuring air into water by a venturi suction at the under pressure side of the pump in the pressurized line. Dissolved air flotation in its simplified version is preferred for algae harvesting in fresh water algae cultures and in high-rate oxidation pond systems, while it is recognized that electroflotation may be preferred in harvesting marine microalgae. (Author's abstract)
W88-07351

AERATION AND WATER HYACINTHS IN WASTE STABILIZATION PONDS,
University of the West Indies, St. Augustine (Trinidad and Tobago). Dept. of Civil Engineering.
P. R. Thomas, and H. O. Phelps.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 265-271, 1987. 4 fig, 5 tab, 6 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Macrophytes, *Aeration, *Water hyacinth, Trinidad, Tropical regions, Stabilization lagoons, Organic matter, Suspended solids.

A poorly designed and overloaded waste stabilization pond system in Trinidad was modified to produce acceptable effluent. After several modifications, a system was developed which could handle a sewage flow more than double the design flow. This arrangement changed the operation from two ponds in parallel to two ponds in series, with surface aerators installed in the first pond and water hyacinths in the second pond. The effluent quality improved to 10 mg/liter total suspended solids and BOD during some months, with additional treatment needed to reduce fecal coliforms. Water hyacinths without aeration did not significantly improve performance. Aeration alone caused significant improvement in effluent quality but was not sufficient to reduce organic matter and suspended solids so that effluent could be discharged into the river. Plans for additional treatment for residual fecal coliforms involved disinfection or maturation ponds. (Cassar-PTT)
W88-07352

BOD REMOVAL IN FLOATING AQUATIC MACROPHYTE-BASED WASTEWATER TREATMENT SYSTEMS,
Reedy Creek Utilities Co., Inc., Lake Buena Vista, FL.
T. A. DeBusk, and K. R. Reddy.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 273-279, 1987. 4 fig, 16 ref.

Descriptors: *Biological oxygen demand, *Carbon removal, *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Macrophytes, Aquatic plants, Water hyacinth, Pennywort, Stabilization lagoons, Biochemical oxygen demand.

Floating macrophytes cultured in ponds used for secondary wastewater treatment (BOD removal) apparently serve two functions: they provide a substrate for bacterial attachment, and their vascular lacunae act as a conduit for the transport of oxygen from the atmosphere to the wastewater. In the present study, floating macrophyte systems containing pennywort (Hydrocotyle umbellata) were found to be 10% more effective (on an annual average) at removing wastewater carbon (BOD) than those containing the more productive water hyacinth (Eichhornia crassipes). This enhancement in BOD removal is thought to be due to pennywort's superior oxygen transport capability. In a separate six-month long study, plant harvesting was found to have no effect on BOD removal in a water hyacinth-based treatment system. These data demonstrate that operational strategies used in floating macrophyte-based nutrient removal systems (i.e., frequent harvest of highly productive plants) are inappropriate for those systems utilized for carbon removal. (Author's abstract)
W88-07353

REMOVAL OF HEAVY METALS AND SEWAGE SLUDGE USING THE MUD SNAIL, CIPANGOPALUDINA CHINENSIS MALLEATA REEVE, IN PADDY FIELDS AS ARTIFICIAL WETLANDS,
Tohoku Univ., Sendai (Japan). Biological Inst.
Y. Kurihara, and T. Suzuki.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 281-286, 1987. 3 fig, 2 tab, 3 ref.

Descriptors: *Wastewater treatment, *Path of pollutants, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Heavy metals, *Snails, *Wetlands, *Sludge, Reeds. Rice, Snails, Metals, Cadmium, Zinc, Copper, Nickel, Manganese, Iron, Tissue analysis, Composting, Land disposal, Stabilization lagoons, Bioaccumulation, Accumulation, Land disposal.

Sewage sludge composted with reeds was spread on submerged paddy fields and populations of mud snails added to assess heavy metal accumulation in the snails and to monitor biodegradation of the sludge. The biomass and growth of newborn snails in the composted fields was superior to that of snails in the paddy soil without added compost. Shell width of newborn snails, which also correlated with dry weight of flesh, clustered within 12-15 mm in compost-fed snails and within 8-11 mm in snails fed plain paddy soil. The amount of daily assimilation per unit body weight showed a sharp decline when the population density was low and approached a maximum value at 70 g/sq m for small snails, 100 g/sq m for medium-sized snails, and 130 g/sq m for large snails. The amount of sludge assimilated decreased gradually with time, reaching a steady value at 15 days. Heavy metals were concentrated in the snail flesh compared with the surrounding soil: cadmium, 2-fold; zinc, 7-fold; copper, 15-fold. Levels of Ni, Pb, Cr, Mn, and Fe in snail flesh were less than those in the soil. The quantities of metals (in micrograms) accumulated in the snail flesh and shells per sq m of plot applied with compost were 20.12 for Cd, 2210 for Zn, and 762 for Cu. It was proposed that harvesting of the snails would then eliminate much of the sludge volume as well as heavy metals. (Cassar-PTT)
W88-07354

WASTEWATER TREATMENT IN STABILIZATION PONDS WITH HIGHER AQUATIC PLANTS,
Department of General and Commune Hygiene, Kiev Medical Institute, Kiev, USSR.
V. I. Tsiprijan, and V. V. Kravets.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 287-288, 1987. 5 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Aquatic plants, *Tertiary wastewater treatment, Industrial wastewater, Agricultural wastes, Macrophytes, Stabilization lagoons, Organic wastes, Oil wastes, Chemical wastes, Industrial wastes, Suspended solids, Nitrogen, Phosphates.

Waste stabilization ponds containing higher aquatic plants improved the efficiency of treatment. Reeds, canes, and rushes were commonly used because they have proved most efficient in the treatment process, which is a year-round phenomenon. High removal efficiency was observed for

several types of wastewaters: domestic organic matter, oil, synthetic surface active agents, phenols, pharmaceutical plants, and sugar refineries. After six days, ponds treating wastes from biochemcial plants and sugar refineries achieved the following reductions: BOD, 99.5%; COD, 96.9%; suspended solids, 99.1%; ammonium-N, 92.8%; phosphates, 99.8%; and general mineralization was 32.7%. (Cassar-PTT)
W88-07355

IRRIGATION REUSE OF POND EFFLUENTS IN DEVELOPING COUNTRIES,
Applied Research and Technology Unit, Water Supply and Urban Development Department, The World Bank, 1818 H St., N.W., Washington, D.C. 20433.
C. R. Bartone, and S. Arlosoroff.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 289-297, 1987. 4 tab, 26 ref. UNDP Projects GLO/80/004 and GLO/84/007.

Descriptors: *Wastewater treatment, *Water reuse, *Irrigation water, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Developing countries, Stabilization lagoons, Pathogens, Agriculture, Water quality, Wastewater renovation, Wastewater irrigation, Arid regions, Semiarid regions, Helminths, Odor control, Biological oxygen demand, Bacteria, Viruses.

The large-scale reuse of sewage for irrigation, often without adequate safeguards, is commonplace in many arid and semiarid regions of the world. A UNDP/World Bank global research project has reviewed available epidemiological data and formulated a risk model to evaluate sanitary control options for effluent irrigation. The study concluded that wastewater treatment processes that effectively remove all or most of the pathogens in wastewater provide a major or total reduction in the negative health effects caused by raw wastewater reuse. Furthermore, the study found the recommended criteria for effective wastewater treatment for irrigation reuse in developing countries to be, in order of priority: (1) maximum removal of helminths; (2) effective reduction in bacterial and viral pathogens; and (3) freedom from odor and appearance nuisances (i.e., reduction of BOD). Multicell stabilization ponds are suited to meet all three criteria. Research sponsored by the UNDP/World Bank project has shown that well-designed and operated multicell stabilization ponds achieve virtually total removal of helminths and a greater than 99.99% reduction of enteric bacteria. Waste stabilization ponds can produce an odor-free effluent rich in nutrients and attractive for agricultural use. Most suitable in hot developing countries, ponds are a particularly robust, flexible and almost fail-safe treatment system having low construction and operation costs. Research is now focusing on management and policy issues required to effectively achieve controlled irrigation reuse. (Author's abstract)
W88-07356

REUSE OF STABILIZATION POND EFFLUENT FOR AGRICULTURAL IRRIGATION IN ISRAEL,
Environmental Engineering and Water Resources Research Center, Technion, Israel Institute of Technology, Haifa 32000, Israel.
G. Shelef, M. Juanico, and M. Vikinsky.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 299-305, 1987. 3 fig, 4 tab, 18 ref.

Descriptors: *Wastewater treatment, *Water reuse, *Irrigation water, *Public health, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Viruses, Agriculture, Wastewater irrigation, Wastewater renovation, Stabilization lagoons, Arid regions, Semiarid regions, Water quality, Israel, Pathogens, Chlorination, Algae, Zooplankton.

The evolution of waste stabilization ponds in Israel has been guided by the intended end-use, irrigation, as well as by high land costs and public health impacts. These factors have led to enlargement of storage capacity and improvement of treatment efficiency. Storage reservoirs, 6 to 12 m deep and with capacities of 50,000 to 1.5 million cu m, were introduced in the 1970s and presently number more than 100 in Israel. Loading and depth are key factors determining performance. The large Kishon complex is the largest wastewater reclamation system for irrigation in this country. It receives chlorinated secondary effluent from the Haifa region. The system consists of a 12 million cu m reservoir divided in halves to prevent short-circuiting, followed by a chlorination facility and an operational reservoir, from which irrigation water is obtained. Developments in improved stabilization pond efficiency include the recirculation system and the high-rate pond. Studies of agricultural workers and residents in 30 kibbutzim with 13,500 residents showed that serum echovirus antibodies were not correlated with wastewater irrigation. The problems of zooplankton and algae in irrigation water are handled by drawing water from the 0.7 to 1.5 m depth where suspended solids are minimum and by filtration with countercurrent cleaning mechanisms. (Cassar-PTT)
W88-07357

REUSE OF STABILIZATION POND EFFLUENT FOR CITRUS RETICULATA (ORANGE), FOREST AND ROAD VERGE PLANTS,
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 3C.
W88-07358

DEEP WASTEWATER RESERVOIRS IN ISRAEL: I. LIMNOLOGICAL CHANGES FOLLOWING SELF-PURIFICATION,
Human Environmental Sciences Division, School of Applied Science and Technology, The Hebrew University of Jerusalem, Israel.
I. Dor, I. Kalinsk, J. Eren, and C. Dimentman.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 317-322, 1987. 3 fig, 1 tab, 6 ref.

Descriptors: *Lakes, *Wastewater treatment, *Tertiary wastewater treatment, *Reservoirs, *Irrigation water, *Self-purification, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Stabilization lagoons, Purification, Ma'ale Kishon Reservoir, Israel, Water quality, Water storage, Storage, Limnology, Eutrophic reservoirs, Water reuse, Dissolved oxygen, Primary productivity, Algae, Zooplankton, Oxygen, Chlorophyll, Nutrients, Phosphates, Respiration.

Ma'ale Kishon Reservoir (surface area of 1,3 sq km, average depth of 9 m, and volume of 12 million cu m) is divided into southern and northern basins by a dam. Secondary effluent enters the northern basin and, after 6 weeks retention, flows into the southern basin. Sampling was conducted monthly or biweekly during April 1985 through July 1986 to document the differences in water quality between the two basins, thus showing the degree of self-purification. The following parameters showed decreases in concentration in the second basin as compared with the first: BOD, 63%; COD, 22%; total suspended solids, 28%; ammonium ion, 36%; phosphate, 25%; coliforms, 96%; heterotrophic bacteria, 50%; algae, 40%; rotifers, 75%; daphnids, 44%. Self-purification also produced increases of 83% in nitrate concentrations and 154% in cyclopoid populations. Dissolved oxygen was generally 3 mg/liter higher at all levels in the southern basin. pH was slightly higher in the southern basin. Chlorophyll a concentrations were higher in the northern basin, except in the first 100 cm of the water column. The rates of primary productivity and of respiration in the upper 1 m layer were lower in the southern basin by 31% and 48%, respectively. (Cassar-PTT)
W88-07359

CLOGGING IN IRRIGATION SYSTEMS REUSING POND EFFLUENTS AND ITS PREVENTION,
Human Environmental Sciences Division, School of Applied Science and Technology, The Hebrew University of Jerusalem, Jerusalem, Israel.
For primary bibliographic entry see Field 3C.
W88-07360

STABILIZATION PONDS IN SOUTHWEST FRANCE: EFFLUENT QUALITY,
Division Qualite des Eaux, CEMAGREF, B.P. 3, F33610 Cestas Principal, France.
P. Boutin, and S. Deux-Sevres.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 329-331, 1987. 7 fig, 2 tab, 2 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Stabilization lagoons, France, Performance evaluation, Seasonal variation, Bacteria, Chemical oxygen demand, Carbon, Nitroge.

Effluent quality data were collected from three stabilization pond systems in France. The single pond systems had poor effluent quality. Hydraulic overloading occurred in winter in the case of single-pond systems or defective multi-pond systems. Seasonal variations were observed in algal populations (higher in summer) and in the ammonium/organic nitrogen ratio (inverted in April-May and September-October). Median values for effluent from 3-4 pond systems were 15-20 mg/liter suspended solids and 40-50 mg/liter for soluble COD. Bacterial concentrations varied widely through the seasons and among the different systems, the single pond having the highest levels. (Cassar-PTT)
W88-07361

FRENCH EXPERIENCE IN THE OPERATION AND MAINTENANCE OF WASTEWATER TREATMENT LAGOONS,
CEMAGREF, Division Qualite des Eaux, Peche et Pisciculture, 3 Quai Chauveau, 69336 Lyon Cedex 09, France.
M. Vuillot, C. Boutin, and M. F. Dupuis.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 333-335, 1987. 1 tab, 1 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *France, *Maintenance, Sludge, Stabilization lagoons.

Routine maintenance tasks associated with waste stabilization ponds include general checking and pretreatment cleaning (once a week), controlling vegetation around ponds (4 times a year), controlling vegetation on dike (twice a year), cutting of macrophytes in macrophyte ponds (once a year), and various small repairs such as removal of floating objects as needed. Sludge management involves checking sludge thickness, elimination of unusually thick deposits (such as near the inlet), and total emptying of the pond about every 10 years. (Cassar-PTT)
W88-07362

ENVIRONMENTAL IMPACT ASSESSMENT OF THE DISCHARGE OF THE EFFLUENT FROM THE FARO WASTE STABILIZATION PONDS INTO THE RIA FORMOSA, ALGARVE, PORTUGAL,
PROCESL, Engenharia Hidraulica e Ambiental, Lda., 67 Rua Castilho, 4th 1200 Lisboa, Portugal.
For primary bibliographic entry see Field 5C.
W88-07363

ALGAL-BACTERIAL PONDING SYSTEMS FOR MUNICIPAL WASTEWATER TREATMENT IN ARID REGIONS,
Kuwait Univ., Safat. Dept. of Civil Engineering.
I. I. Esen, K. Puskas, I. Banat, and R. A. Daher.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 341-343, 1987.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Algae, *Bacteria, *Arid regions, Stabilization lagoons, Pilot plants, Water reuse, Biological oxygen demand, Chemical oxygen demand, Coliforms, Bacterial analysis.

A pilot plant was constructed to investigate the use of algal-bacterial systems to treat municipal wastewaters in arid regions. The plant consisted of sand and oil traps, weir tanks, two facultative

ponds (250 cu m each), two high-rate ponds (25 cu m each), four sedimentation tanks, a sludge digester, and auxiliary facilities. The effluent was scheduled for use in irrigation; the algae, as a soil conditioner. Preliminary results indicated that more than 60% of BOD and more than 50% of COD were removed in spite of relatively concentrated raw sewage (300-600 mg/liter BOD). Total bacterial counts in effluent were 10% of that in raw sewage. Total coliform counts were reduced by 95%. The main algal population is Scenedesmus and Chlamydomonas in the facultative ponds and Scenedesmus in the high-rate ponds. (Cassar-PTT)
W88-07364

SEWAGE STABILISATION PONDS IN ARABIA AND KENYA,
Taylor (John) and Sons, London (England).
L. J. Smith.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 345-347, 1987. 1 tab.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Design criteria, *Biological wastewater treatment, Saudi Arabia, Kenya, Aden, Yemen, Stabilization lagoons, Seepage, Evaporation, Water losses.

Design criteria for waste stabilization ponds constructed in several countries are described. These include six operating systems and four designed-but-not-constructed systems in Saudi Arabia, Yemen, Aden, and Kenya. Performance data are not available. Situations in which stabilization ponds are not suitable are high evaporation or seepage loss, high algal concentrations, and uncertain, highly variable effluent quality. (Cassar-PTT)
W88-07365

STUDIES ON HIGH ALTITUDE WASTE STABILIZATION PONDS IN PERU,
Liverpool Univ. (England). Dept. of Botany.
H. W. Pearson, D. D. Mara, W. Thompson, and S. P. Maber.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 349-353, 1987. 4 tab, 7 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Design flow, *Biological wastewater treatment, Peru, High altitude regions, Design criteria, Stabilization lagoons, Temperature, Light, Sludge.

Studies on waste stabilization ponds at Cajamarca (altitude, 2675 m) and Juliaca (3827 m) in Peru have shown that existing pond design equations can be confidently used for designing ponds for high Andean towns, even though there are large diurnal variations in air temperatures and high light intensities. Some caution must be exercised above 3500 m, however, since safety margins are reduced. Sludge accumulation was minimal, despite the pond water temperatures being lower than 15 C in the region of the sediments. (Author's abstract)
W88-07366

IMPROVEMENT OF OXIDATION POND EFFLUENT QUALITY BY SAND FILTRATION,
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
I. Somiya, S. Fujii, and K. Takeda.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 355-357, 1987. 5 fig, 1 tab.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Filtration, *Oxidation ponds, Model studies, Tertiary wastewater treatment, Stabilization lagoons, Kinetics, Sand filters.

A mathematical model was developed to study sand filtration of waste stabilization pond effluent. The degradation of the filter deposit followed a first-order reaction at a filtration rate >5 m/day and a zero-order reaction at a rate <1 m/day. The maximum deposit in the sand filtration bed was determined to be about 0.3 kg/sq m of the bed surface area at the rate of 0.5 to 1 m/day and 0.2 kg/sq m at 5-10 m/day. (Cassar-PTT)
W88-07367

ULTRAVIOLET RADIATION AND SEDIMENTATION OF WASTEWATER LAGOON EFFLUENTS,
Tennessee Technological Univ., Cookeville. Center for the Management, Utilization and Protection of Water Resources.
V. D. Adams, E. C. Nieminski, and M. B. Borup.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 359-361, 1987. 1 fig, 1 tab, 4 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Wastewater lagoons, *Ponds, *Biological wastewater treatment, *Ultraviolet radiation, *Sedimentation, *Disinfection, Algae, Bacteria, Suspended solids, Tertiary wastewater treatment, Stabilization lagoons. *Coliforms, Hydrogen ion concentration, Turbidity, Nitrogen, Phosphorus, Metals, Streptococcis.

A process consisting of ultraviolet radiation followed by sedimentation was used to remove suspended solids from a wastewater lagoon effluent treated in a series of seven lagoons. The experimental treatment removed 33% of suspended solids, 45% of volatile suspended solids, 54% of BOD, 66% of total coliforms, 78% of fecal coliforms, and 49% of fecal streptococci. No significant changes occurred in pH, turbidity, nitrogen and phosphorus compounds, and metals concentrations. (Cassar-PTT)
W88-07368

STEEL INDUSTRY WASTES TREATMENT IN BUFFER PONDS,
Department of Biochemistry, N.G. Kholodny Institute of Botany, Academy of Sciences of Ukrainian SSR, Kiev, USSR.
V. M. Bagnyuk.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 363-364, 1987. 3 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Self-purification, *Biological wastewater treatment, *Industrial wastes, *Steel industry, Purification, Costs, Turbidity, Phosphorus, Microorganisms, Algae, Bacteria, Stabilization lagoons.

A study of self-purification of steel industry wastes in buffer ponds showed that about 6 species of microalgae and many types of bacteria were present. Unusual organisms included a group of lytic microorganisms and filamentous and mycoplasma-like microorganisms which aid in precipitation of iron and manganese as hydroxides. The main limiting factor was high turbidity and deficiencies of dissolved phosphorus and oxygen. Efficiency was improved by addition of deficient substances, such as soluble phosphates, a much cheaper method than aeration. (Cassar-PTT)
W88-07369

CIVIL ENGINEER'S POINT OF VIEW ON WATER TIGHTNESS AND CLOGGING OF WASTE STABILIZATION PONDS,
CEMAGREF, Division Mecanique des Sols et Genie Civil, B.P. 121, 92164 Antony Cedex, France.
C. Bernhard, and N. Kirchgessner.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 365-367, 1987. 2 fig, 6 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Leakage, *Seepage, *Soil properties, Performance evaluation, Clogging, Stabilization lagoons, France.

A survey of 612 waste stabilization ponds built in 1983-1986 in France was concerned with causes and location of leaks. About 25% had leakage problems, mainly on the pond bottom. This problem was blamed on insufficient preliminary geotechnical study, poor construction, delayed filling of the pond, or insufficient initial influent flow. Clogging develops in some cases and seals the leaks. Conditions favorable to clogging are high total suspended solids concentrations, high organic matter concentrations in soil, sandy soil, and low hydraulic gradient. (Cassar-PTT)
W88-07370

EFFECTS OF LAGOON TREATMENT ON HELMINTH EGGS,
Department de Microbiologie, Faculte de Pharmacie, 5 Rue Albert Lebrun, 54000 Nancy, France.
J. Schwartzbrod, K. Bouhoum, and B. Baleux.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 369-371, 1987. 10 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Eggs, *Helminths, Pathogens, Stabilization lagoons, Marrakech, Public health, Sludge disposal.

The effect of lagoon treatment on the elimination of helminth eggs was studied in the Marrakech system, which consists of two connected ponds (total retention time, 8-10 days). In the surface water at the lagoon inlet the helminth egg concentration averaged 11.7 per liter; none were found at the lagoon outlet. Only about 3 eggs per liter were found in pond surface and deep water samples. However, eggs were discovered in the sediments at concentrations of 275 eggs/100 g sediment in the first basin and 158 eggs/100 g sediment in the second basin. Although lagoon treatment was effective in removing helminth eggs from the water, their presence in the sediment makes safe sludge disposal a problem. (Cassar-PTT)
W88-07371

DOMESTIC WASTEWATER TREATMENT IN TANKS WITH EMERGENT HYDROPHYTES: LATEST RESULTS OF A RECENT PLANT IN FRANCE,
CEMAGREF, Division qualite des Eaux, Peche et Pisciculture, 3 Quai Chauveau 69336, Lyon Cedex 09, France.
A. Lienard.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 373-375, 1987. 1 fig, 1 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Macrophytes, Aquatic plants, France, Performance evaluation, Pilot plants, Stabilization lagoons.

A pilot plant for treating domestic wastewater in concrete tanks filled with aquatic plants was constructed. The first stage consisted of 48 parallel tanks with 80 sq m surface area each, one planted with Phragmites communis, two with Glyceria aquatica, and one unplanted. The second stage was composed of 2 tanks planted with Phragmites. These were followed by three tanks in series, planted with Scirpus (third and fourth tanks) and iris (fifth tank). Problems which remain to be solved are poor aeration, rapid clogging, insufficient nitrification, low oxidoreduction potentials, unpleasant odors, and difficulty in establishing vigorous plant growth. (Cassar-PTT)
W88-07372

DEVELOPMENT AND APPLICATION OF AN ENERGY UTILIZATION SYSTEM FOR ORGANIC WASTEWATERS,
Guizhou Provincial Institute of City Planning and Design, 9 An Yun Road, Guiyang, Guizhou, China.
C. Shinian, and Y. Guangyu.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 377-380, 1987. 2 fig, 2 tab, 5 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, Upflow towers, Oxidation ponds, Aquatic plants, Energy, Solar energy, Meat processing industry, Anaerobic digestion, Photosynthesis, China, Stabilization lagoons, Animal wastes, Methane, Biological oxygen demand, Chemical oxygen demand.

High-energy aquatic plants are used in a pond treatment system in place of the usual algal-bacteria system. Suggestions for regions with insufficient land area for ponds include (1) placing in areas scheduled for afforestation, (2) using hill-

sides, upflow towers, and step-like arrangements, and (3) enhancing treatment with anaerobic processes. Plants grown in the ponds may be anaerobically digested to yield energy-producing methane. A small system designed for 200 cu m/day of wastes from an animal products factory was made in the form of a four-level tower of ponds. In the middle of the tower was an upflow anaerobic sludge blanket reactor. COD and BOD removal were both 92%. (Cassar-PTT)
W88-07373

EFFECT OF PH ON THE PERFORMANCE OF HIGH-RATE OXIDATION PONDS,
Environmental and Water Resources Engineering, Technion, Haifa 32000, Israel.
Y. Azov, and G. Shelef.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 381-383, 1987. 4 fig, 7 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Hydrogen ion concentration, *Oxidation ponds, *Algae, Performance evaluation, Ammonia, Hydrochloric acid, Carbon dioxide, Photosynthesis, Biomass, Ammonia, Toxicity, Stabilization lagoons.

The pH rise seen in high-rate oxidation ponds is usually followed by a decrease in algal performance and in overall pond performance. Although the direct effects of the pH rise are minor, the indirect effects are major: alterations in the ratios of the carbonate species and ammonia dissociation. Limitation of dissolved carbon dioxide by addition of hydrochloric acid suppresses algal growth; using carbon dioxide as the pH regulator increases algal growth over that of the control ponds. At a constant total ammonia concentration of 5 mM, variation in pH dramatically affects algal photosynthesis. Carbon assimilation is reduced by 90% between pH values of 8.2 and 8.7. Reduction of ammonia concentration by evaporation restores algal growth and the progression toward higher pH. (Cassar-PTT)
W88-07374

MICROALGAL HARVESTING BY IN SITU AUTOFLOTATION,
Environmental and Water Resources Engineering Center, Technion, Israel Institute of Technology, Haifa, 32000, Israel.
E. Sandbank, and L. J. van Vuuren.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 385-387, 1987. 4 fig, 4 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Algae, *Flotation, Polyelectrolytes, Dissolved air flotation, Oxygen, Stabilization lagoons, Bubbles.

Dissolved air flotation principles were applied to harvest microalgae from high-rate algal pond effluents in a highly simplified system which consisted of a open channel and a dosing pump only. Polyelectrolyte solution was dosed into the channel through a diffuser in the vicinity of a paddle wheel, where rapid mixing occurred. Slow mixing took place in the channel. While flocs grew, oxygen bubbles resulting from algae photosynthetic activity were entrapped. Floating flocs were removed manually at the end of the channel. Removal efficiencies of 90% were obtained at a 10-mg polyelectrolyte dose. The float had 4-6% solids which dewatered easily to 10% solids. (Author's abstract)
W88-07375

WASTE STABILIZATION PONDS AS TEACHING AND RESEARCH TOOLS,
Department of Chemistry, The University, 3800 Aveiro, Portugal.
A. Hall, A. C. Duarte, and J. P. Oliveira.
Water Science and Technology WSTED4, Vol. 19, No. 12, p 389-391, 1987.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Ponds, *Biological wastewater treatment, *Anaerobic digestion, *Research facilities, *Education, Stabilization lagoons, Portugal, Biological oxygen demand, Suspended solids, Fish, Laboratories.

A waste stabilization pond system can be integrated into the grounds of a college or university campus for teaching students and demonstrating to the community. One such unit, comprising one photosynthetic pond and one macrophyte pond in parallel, followed by one fish pond and one irrigation pond in series, was built at the Faro Polytechnic in Portugal. The ponds are preceded by an underground unit formed by three septic tanks in series followed by two upflow anaerobic filters in parallel. The system can handle 120 cu m/day of a mixed effluent (600 mg/liter in both BOD and suspended solids) from the sanitary facilities, the refectory, and the fish processing laboratory. (Cassar-PTT)
W88-07376

DISCOVERY AND ELIMINATION OF DIOXINS FROM A CARBON REACTIVATION PROCESS,
Cincinnati Water Works, OH.
J. DeMarco, R. Miller, and D. J. Hartman.
Journal of the A.nerican Water Works Association JAWWA5, Vol. 80, No. 3, p 66-72, March 1988. 7 fig, 11 tab, 16 ref.

Descriptors: *Water treatment, *Fluid bed process, *Activated carbon, *Dioxins, *Chlorinated hydrocarbons.

After completion of a long-term granular activated carbon (GAC) project, the US Environmental Protection Agency informed the Cincinnati Water Works about the possible formation of dioxins during carbon reactivation. This information prompted the utility to conduct an additional study on avoiding potential dioxin precursor materials and on evaluating a reactivation system capable of preventing adverse environmental emissions. Studies were conducted for exhausting GAC in a post-filtration carbon contactor and reactivating GAC in a fluid bed reactivation system. The health risks posed by the levels of furans and dioxins detected are insignificant. Performance of two sequential phases showed that chlorinating water before rather than after GAC treatment increased the levels of dioxins detected during GAC reactivation. Even with prechlorination, however, the reactivation system stack emissions were well below any credible risks. (Sand-PTT)
W88-07382

SEASONAL CHANGES AND EFFLUENT LIMITS,
Limno-Tech, Inc., Ann Arbor, MI.
P. L. Freedman, J. F. Pendergast, C. Wilber, and S. C. Chang.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 316-323, March 1988. 9 fig, 1 tab, 7 ref.

Descriptors: *Municipal wastewater, *Low flow, *Wastewater treatment, *Water quality control, Seasonal treatment, Model studies, Monte Carlo, Simulation.

The last decade has seen increased use of wastewater treatment beyond secondary municipal treatment and categorical industrial standards. However, these higher levels of wastewater treatment are generally only needed to maintain water quality standards during critical low-flow summer conditions. Today many states allow relaxed effluent limits during winter months. This can permit smaller facility design or reduction in the annual operating costs. The benefits of seasonally relaxed effluent limits are obvious, but the means to identify a specific plan for relaxation are more difficult. There is no one recommended method for conducting this analysis. Three methods were compared that establish appropriate schedules for seasonal treatment based on water quality considerations: conventional simulation at monthly critical stream conditions, continuous simulation over 22 years, and probabilistic Monte Carlo simulation. The continuous and Monte Carlo methods are preferred because they provide a quantitative assessment of water quality at all conditions and allow for an objective cost benefit analysis without the problems of choosing critical conditions. (Sand-PTT)
W88-07417

OXYGEN TRANSFER UNDER PROCESS CONDITIONS,
Manhattan Coll., Bronx, NY. Dept. of Civil Engineering.
J. A. Mueller, and W. C. Boyle.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 332-341, March 1988. 6 fig, 4 tab, 13 ref.

Descriptors: *Wastewater treatment, *Oxygen transfer, *Mass transfer, *Aerators, Radioactive tracers, Dissolved oxygen.

Five procedures used to evaluate oxygen transfer under process conditions were examined. Steady and non-steady state analyses, radioactive and non-radioactive tracer techniques, and off gas methods were evaluated in side by side comparisons at six municipal and industrial wastewater treatment plants employing both diffused and mechanical aeration. Off gas, inert gas tracer, and nonsteady-state procedures estimated field oxygen transfer coefficients within 10% of each other and sum to represent the best state-of-the-art methods for measuring oxygen transfer rate under process conditions. Method choice will depend on economics and treatment plant site constraints. Steady-state testing using oxygen uptake rates, although the easiest procedure to conduct, is not recommended because it may significantly over- or underestimate the real oxygen transfer rate. (Sand-PTT)
W88-07418

NITRATE VERSUS OXYGEN RESPIRATION IN THE ACTIVATED SLUDGE PROCESS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
S. A. McClintock, J. H. Sherrard, J. T. Novak, and C. W. Randall.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 342-350, March 1988. 11 fig, 6 tab, 13 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Oxygen respiration, *Nitrate respiration, Kinetics, Aerobic conditions, Anaerobic conditions, Chemical oxygen demand, Sludge.

Biokinetic and microbial growth coefficients for nitrate vs. oxygen respiration in the activated sludge process were evaluated and compared. Two bench-scale activated sludge units were operated over a range of mean cell residence times and under the same conditions except that one unit was aerobic and the other anoxic. The maximum microbial yield coefficient, Ymax, and the endogenous decay coefficient, kd, were lower and the maximum substrate utilization rate, k, was higher for nitrate respiration vs. oxygen respiration. COD removal efficiencies were nearly equal at corresponding mean cell residence times. Sludge production was approximately 40% smaller for anoxic conditions when compared to aerobic conditions for similar mean cell residence times < 10 days. (Author's abstract)
W88-07419

SSSP: SIMULATION OF SINGLE-SLUDGE PROCESSES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
S. M. Bidstrup, and C. P. L. Grady.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 351-361, March 1988. 5 fig, 8 tab, 15 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Computer programs, *Computer models, *Simulation, Oxidation, Nitrification, Denitrification.

An interactive, user-friendly microcomputer program is described that uses a developed model to

simulate as a chain of completely mixed reactors, activated sludge systems performing carbon oxidation, nitrification and denitrification. The Turbo Pascal code was written for IBM-PC compatible microcomputers having a minimum of 128K RAM. Support is provided for an 8087 math processor. The user may specify plant configuration; reactor sizes; influent, recycle, and recirculation flow rates; the desired solids retention time; the kinetic parameters; and the time-dependent patterns of influent flows and concentrations. The program may be used to compute both steady state and time-dependent performance. Other program features include spreadsheet style data entry; formatted output; extensive error trapping; interrupts to DOS system command; and subroutines for plotting, calculating, and storing process parameters. (Author's abstract)
W88-07420

COMPARATIVE STUDY OF BIOFILM SHEAR LOSS ON DIFFERENT ADSORPTIVE MEDIA,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
H. T. Chang, and B. E. Rittman.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 362-368, March 1988. 7 fig, 2 tab, 16 ref. EPA Cooperative Agreement CR810462.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Biofilms, *Activated carbon, Model studies, Kinetics.

Effects of the attaching surface on biofilm shear loss and accumulation were investigated using two granular activated carbons (GAC) with very different surface structures. Experimental evaluations were performed with a completely-mixed flow reactor. The BFAC (biofilm on activated carbon) model was used to interpret the experimental results. Results showed that a very irregular carbon surface provided better protection for initial biofilm growth and an earlier start for bioregeneration than did the spherical medium. The initial biofilm loss rates for the two carbons were 0.0 and 0.2/day, respectively and the shear loss rate coefficients were increased to 0.6 to 1.2/day for both carbons after complete growth. During a period of rapid biofilm growth and GAC bioregeneration, the biofilm loss rate increased as a complex function that could not be described by a simple first-order loss function. (Author's abstract)
W88-07421

ALUMINUM RECLAMATION BY ACIDIC EXTRACTION OF ALUMINUM-ANODIZING SLUDGES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-07422

RAPID SYNERGISTIC EXTRACTION AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF IRON IN ENVIRONMENTAL SAMPLES USING TRIBUTYL PHOSPHATE AND N-PHENYL-2-FURYLACRYLOHYDROXAMIC ACID,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
For primary bibliographic entry see Field 5A.
W88-07436

STRUCTURAL BEHAVIOUR OF CLOSELY PACKED EGG-SHAPED SEWER LININGS DURING INSTALLATION AND UNDER VARIOUS RESTRAINT CONDITIONS,
WRC Engineering, Swindon (England).
For primary bibliographic entry see Field 8B.
W88-07476

MICROCOMPUTERS CAN AID IN SANITARY SEWER SYSTEM ANALYSIS AND DESIGN,
James Miertschin and Associates, Inc., Austin, Texas.
T. E. Capone.
Public Works PUWOAH, Vol. 119, No. 2, p 71-74, February 1988. 2 fig, 1 tab.

Descriptors: *Wastewater treatment, *Sewer systems, *Computer programs, *Planning, *Waste disposal, *Design criteria, Design standards, Economic aspects, Population growth.

Municipal sewage collection systems tend to evolve through a series of expansions and improvements to the original system. In growing communities, new demands for wastewater service require system expansion and may place doubts on the ability of the existing system to transport the additional sewage flow adequately. Computer analysis enabled the effects of a range of population growth scenarios upon pipe size to be determined for each pipe segment during both preliminary and final design phases. For example, the procedure used during the design phase was to design the interceptors to accommodate a 'design' population growth scenario and to determine which segments would not accommodate a high growth rate scenario. Often, minor adjustments to the final design (with minor effects on project cost) or a slightly less conservative design criteria would accommodate the higher population growth scenario. Likewise, an analysis of the utilization of the final design under the lower growth rate scenario and for interim service area populations was also conducted to verify cost effectiveness and project hydrogen sulfide generation rates. These analyses illustrated that in general pipe sizes and slopes in smaller service areas are more sensitive to the possible ranges of population growth than those in larger service areas, large service areas with fixed service area boundaries are fairly insensitive to various long term population projections, and the effects of pumpage into a service area should be analyzed, particularly for growth areas on the urban fringe. (Alexander-PTT)
W88-07482

WASTEWATER TREATMENT PLANT BEGINS TO AUTOMATE,
Wastewater Treatment Facilities, Tonawanda, NY.
J. Camilleri.
Public Works PUWOAH, Vol. 119, No. 3, p 70-71, March 1988.

Descriptors: *Wastewater treatment, *Computer programs, *Sewer systems, *Cost-benefit analysis, Economic aspects, Tonawanda.

As the first step in a program to automate its eight-year-old wastewater treatment plant, the town of Tonawanda, New York, is monitoring three wet air oxidation units through use of a powerful programmable logic controller (PLC) operated by a touch-screen color graphics computer. Subsequent projects include the cryogenic oxygen generating plant, the main sewer control area, and the sand filter control room. These operations will be automated last because calculated paybacks are the longest and existing equipment is still in fairly good condition. Automation hardware for these last three projects will consist of three Gould 984 PLCs and one Modvue terminal. The PLCs will be located in the plant control center (to remove them from harsh atmospheres) and will communicate over coaxial cables with remote I/O panels in the field. The graphics terminal with also be located in the control center. Each major area of the plant is being assigned its own PLC so loss of a single controller will not affect large portions of the facility. Any of the three graphics terminals, however, will be able to separately and simultaneously access data, display pages for, and monitor and operate equipment assigned to any of the five controllers. (Alexander-PTT)
W88-07483

COORDINATED EFFORTS SOLVE BACKWATER PROBLEM,
Bureau of Engineers, Milwaukee, Wisconsin.
R. K. Talwalker.
Public Works PUWOAH, Vol. 119, No. 3, p 82-83, March 1988.

Descriptors: *Sewer systems, *Storm sewers, *Relief sewers, *Construction, *Milwaukee, Design criteria, Design standards, Planning, Urban areas.

A 100-year plus frequency storm produced seven inches of rain in some areas of Milwaukee causing serious flood damage. As a result the city has undertaken several construction projects to rehabilitate failing drainage systems in selected drainage areas. One such project, in North Summit Avenue, involves the construction of a 48-in. diameter relief sewer in a tunnel and the relaying of 2,000 ft of the existing combined service sewers, varying in sizes from 15- to 36-in. diameter. Design and construction inspection are provided by the city. A number of investigative procedures and activities had to be conducted to provide sufficient field information before design decisions could be made: Examination of existing sewers to determine structural conditions. Subsurface soil investigations to predict foundation conditions. Relative location of existing utilities to avoid interferences. Present and projected needs of the drainage system. The cost of this project was $1.5 million. The cost of design engineering and construction administration involves a small portion of the total expenditure of the project (less than eight percent of the construction cost). Nevertheless, the planning and design functions have a significant impact on the trouble-free construction and operation of the sewer system. Sophisticated and difficult to build and maintain structures should not be designed for any sewer system. Ease of construction and timely completion of sewer projects largely depend on strict adherence to standard procedures and traditional construction methods. (Alexander-PTT)
W88-07484

REMOVAL OF OILY CONTAMINANTS IN WASTEWATER WITH MICROPOROUS ALUMINA MEMBRANES,
Alcoa Separations Technology Division, Warrendale, PA 15086.
R. R. Bhave, and H. L. Fleming.
AICHE Symposium Series, Vol. 84, No. 261, p 19-27, 1988. 8 fig, 3 tab, 17 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Oily water, *Filtration, *Membrane filters, Membrane processes, Grease, Permeability, Fluctuation, Water quality control, Filtered wastewater, Particulates, Alumina membranes.

The discharge of industrial wastewaters containing oily contaminants such as motor oils, greases, and vegetable oil processing wastes into the sewer is regulated by increasingly tighter state and federal environmental standards. The feasibility of utilizing Membralox alumina membranes for oil and grease removal from a typical industrial wastewater stream was investigated. some performance data such as the quality of permeate produced, permeate flux, and water permeability with Membralox alumina membranes are presented. It was found that microporous alumina membranes are suitable for the removal of oil, grease, and particulate matter from these wastewaters. The permeate (filtrate) was found to contain only 3 to 5 mg/L of oil and grease. The flux of filtered wastewater through Membralox alumina membranes was found to be highly stable. Backflushing was found to be effective in maintaining high flux values, whereas a higher cross-flow velocity resulted in higher flux with no appreciable flux decay over longer periods of operation. Alumina membranes were also found useful in dewatering oily wastewaters and more than 90% reduction in original volume was obtained without any significant decay. (Friedmann-PTT)
W88-07502

INDUCED AERATION WINDROW COMPOSTING OF RAW SLUDGES,
For primary bibliographic entry see Field 5E.
W88-07506

ADSORPTION OF POLLUTANTS FROM WASTEWATER ONTO ACTIVATED CARBON BASED ON EXTERNAL MASS TRANSFER AND PORE DIFFUSION,

Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, and M. J. Bino.
Water Research WATRAG, Vol. 22, No. 3, p 279-286, March 1988. 11 fig, 2 tab, 18 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Activated carbon, *Adsorption, *Organic compounds, *Mass transfer, *Phenols, Surfactants, Mercury, Heavy metals, Metals, Chlorophenol, Model studies, Water treatment, Kinetics.

A mass transfer model was developed based on external mass transfer and pore diffusion to describe the adsorption of four pollutants from wastewater onto activated carbon in a well agitated batch adsorber. Pollutants were phenol, p-chlorophenol, sodium dodecyl sulfate, and mercuric chloride. The carbon was Filtrasorb 400. The experimental curves were correlated with the model predictions with reasonable accuracy using a single constant external mass transfer coefficient and a single constant pore diffusion coefficient for each solute/carbon system. (Cassar-PTT)
W88-07538

CONTINUOUSLY FED INTERMITTENTLY DECANTED ACTIVATED SLUDGE: A RATIONAL BASIS FOR DESIGN,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman.
Water Research WATRAG, Vol. 22, No. 3, p 303-311, March 1988. 7 fig, 2 tab, 5 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Design criteria, Biological wastewater treatment, Kinetics, Biomass.

A rational design procedure for the continuously fed intermittently decanted activated sludge system was developed. It allows selection of reactor dimensions and cycle time based on hydraulics, settleability and reaction kinetics considerations. For any given nominal hydraulic residence time and biomass concentration there is a limited range of cycle times that can be used. Removal of soluble organics can be predicted in systems with no significant denitrification during the anoxic period of the cycle. This was confirmed in laboratory tests on bench scale systems. Long residence times and short cycle times are conducive to higher removals. Shallow depth and low biomass concentrations allow shorter cycle times leading to improved organic removals. (Author's abstract)
W88-07541

DETECTION OF HUMAN ROTAVIRUS IN SEWAGE THROUGH TWO CONCENTRATION PROCEDURES,
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W88-07546

EVALUATION OF INT-DEHYDROGENASE ASSAY FOR HEAVY METAL INHIBITION OF ACTIVATED SLUDGE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
K. Anderson, B. Koopman, and G. Bitton.
Water Research WATRAG, Vol. 22, No. 3, p 349-353, March 1988. 2 fig, 3 tab, 30 ref.

Descriptors: *Inhibition, *Wastewater treatment, *Activated sludge process, *Heavy metals, *Toxicity, Metals, INT-dehydrogenase assay, Sludge, Dehydrogenase assay.

A dehydrogenase assay using the redox dye 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) was compared to oxygen uptake for assessing heavy metal inhibition of activated sludge. The median inhibitory concentrations (IC50) measured with the two tests were similar for Cd(++), Cu(++), Hg(++), Pb(++), and Zn(++). The INT-dehydrogenase test was less sensitive to Ni(++) toxicity than the oxygen uptake test. INT test results also compared favorably with IC50 values published for other dehydrogenase assays. (Cassar-PTT)
W88-07547

SURVEY OF MUNICIPAL ANAEROBIC SLUDGE DIGESTERS AND DIAGNOSTIC ACTIVITY ASSAYS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
R. E. Speece.
Water Research WATRAG, Vol. 22, No. 3, p 365-372, March 1988. 6 tab, 6 ref. Dept. of Energy Contract No. 31-109-38-7196 and EPA Contract No. R-81063-01-0.

Descriptors: *Wastewater treatment, *Sludge, *Digestion, *Anaerobic digestion, Biological treatment, Methanogenesis, Iron, Cobalt, Nickel.

A plant site survey was made of 30 municipal wastewater treatment plants concerning the operational characteristics of their anaerobic sludge digesters. Design information, operating data, and analytical data were tabulated. Samples of each sludge were then assayed to determine the residual gas production rate, the maximum potential acetate and propionate utilization rates, and 5 and 30 day biochemical methane potential (BMP5 and BMP30), and the possible limitation in bioavailability of iron, cobalt, or nickel. The average solids content of the raw sludge fed to the digesters was 4.7%. Eight of the 30 sludges showed stimulation in the gas production rate when iron, cobalt, or nickel was supplemented and acetate was unlimiting. Average values were as follows: BMP5, 0.7 volumes of methane per volume of sludge; BMP30, 1.9 volumes of methane per volume of sludge; biodegradable fraction of sludge converted to methane during digestion, 87%; maximum potential acetate utilization rate, 0.93 vol CH4/vol sludge-day; maximum potential propionate utilization rate; 0.18 vol CH4/vol sludge-day; hydrogen sulfide in the digester gas, 2200 ppm; digester capacity, 0.14 million gal/million gal per day of raw wastewater; raw sludge pumping rate, 4300 gal per million gal of raw wastewater; digester gas production, 0.066 vol gas/vol of raw wastewater; unit gas production rate, 0.64 volumes of digester gas per volume of digester per day; digester gas produced per volume of raw sludge feed, 15.8 v/v; gas production per pound of volatile solids added, 0.46 cu mg/kg; gas production per pound of volatile solids destroyed, 0.94 cu m/kg. (Cassar-PTT)
W88-07549

SIGNIFICANCE OF BIOSORPTION FOR THE HAZARDOUS ORGANICS REMOVAL EFFICIENCY OF A BIOLOGICAL REACTOR,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
M. Tsezos, and J. P. Bell.
Water Research WATRAG, Vol. 22, No. 3, p 391-394, March 1988. 1 fig, 3 tab, 8 ref.

Descriptors: *Wastewater treatment, *Pesticides, *Organic compounds, *Activated sludge process, *Sludge, Lindane, Pentachlorophenol, Chlorinated hydrocarbons, Biological wastewater treatment, Toxicity, Biosorption, Adsorption, Accumulation, Bioaccumulation.

In the activated sludge process biosorption proved to be a significant mechanism for removal of lindane and pentachlorophenol, chosen as samples of non-biodegradable organic pollutants. Pilot plant data from a previous study and biosorption equilibrium data were used to calculate the pollutant concentrations in an effluent and in the resulting sludge. For pentachlorophenol the bioconcentration factor was calculated to be 40.7 using a reactor concentration of 6.3 microgram/liter at 20 C; for lindane, 0.64 at a reactor concentration of 25.8 microgram/liter. Agreement between calculated and measured results was satisfactory for lindane in effluent and sludge and for pentachlorophenol in effluent; however, pentachlorophenol in sludge was overpredicted. Nevertheless, the pollutants bioaccumulated in the sludge can be a significant hazard upon sludge disposal. (Cassar-PTT)
W88-07552

CILIATES IN A WASTES STABILIZATION POND SYSTEM IN MEXICO,
Ave. Univerisdad 220-4, Mexico 03020, D.F. Mexico.
F. Rivera, M. R. Sanchez, A. Lugo, P. Ramirez, and R. Ortiz.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 3, p 245-262, July 1987. 3 fig, 6 tab, 35 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Microbiological studies, *Ciliates, Species composition, Anaerobic conditions, Physical properties, Mexico.

A protozoological survey was performed on a waste-stabilization pond to isolate, identify, and determine the incidence of ciliates present in these waters. The correlation between the species found and the physicochemical parameters was investigated. One hundred and eighty samples were analyzed from February 1983 to February 1984. Free-living ciliates isolated include: Carchesium polypinum Linnaeus, Vorticella microstoma Ehrenberg, Vorticella convallaria Linnaeus, Didinium balbiani Fabre-Domergue, Amphileptus claparedei Stein, Spathidium spathula Muller, Litonotus fasciola Ehrenber, Paramecium caudatum Muller, Paramecium aurelia Ehrenberg, Tetrahymena vorax Kidder, Tetrahymena pyriformis Ehrenberg, Cyclidium glaucoma Muller, Aspidisca costata Ehrenberg, and Stylonychia putrina Stokes. The performance of the pond was predominantly anaerobic. The temperature, total alkalinity, and nitrate concentration were the most variable parameters in the system studied. (Author's abstract)
W88-07592

BIOPARTICULATE SOLUBILIZATION AND BIODEGRADATION IN SEMI-CONTINUOUS AEROBIC THERMOPHILIC DIGESTION,
Inst. of Aquatic Sciences, Swiss Federal Inst. of Technology Zurich, Switzerland.
C. A. Mason, G. Hamer, T. Fleischmann, and C. Lang.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 4, p 399-407, August 1987. 7 fig, 11 ref.

Descriptors: *Aerobic digestion, *Wastewater treatment, *Biological wastewater treatment, *Biodegradation, *Performance evaluation, Organic carbon, Microbiological studies, Nutrients, Nitrogen.

The effects of charge size, cycle time, and the presence of added N on the extent of solubilization and biodegradation of microbial solids were investigated during semi-continuous operation of an aerobic thermophilic digestion process. Use of a charge size of 50% of the bioreactor operating volume resulted in the removal of more than 59% of the total suspended solids concentration in the feed and showed enhanced performance compared with when a 25% charge size was used. The addition of a supplementary N source resulted in enhanced dissolved organic carbon (DOC) concentrations with the 50% charge size, but did not affect overall solids removal. With the 25% charge size, addition of a supplementary N source resulted in an overall improvement in process performance. (Author's abstract)
W88-07597

SYNTHESES AND APPLICATION OF ANIONIC POLYELECTROLYTES IN WATER AND WASTEWATER TREATMENT,
Central Power Research Inst., Bangalore (India).
For primary bibliographic entry see Field 5F.
W88-07602

INFRASTRUCTURE INTERROGATION AND SYSTEMATIC REHABILITATION ALTERNATIVES PROGRAM,
City of West University Place, Texas.
For primary bibliographic entry see Field 6B.
W88-07652

EFFECT OF COMPLEXATION ON THE ADSORPTION OF CADMIUM BY ACTIVATED CARBON,
A. J. Rubin, and D. L. Mercer.

Separation Science and Technology SSTEDS, Vol. 22, No. 5, p 1359-1381, 1987. 8 fig, 4 tab, 18 ref.

Descriptors: *Chelation, *Chelating agents, *Cadmium, *Adsorption, *Activated carbon, *Chemical treatment, Carbon, Water treatment, Hydrogen ion concentration, Wastewater treatment, Zinc, Lead, Heavy metals, Kinetics, Isotherms, Model studies.

The adsorption of Cd(++) in the absence and presence of two chelating agents was examined as a function of pH. Fits of the data to the Freundlich and Langmuir equations were compared as were results with Zn and Pb using four different activated carbons. Adsorption was found to increase with increasing pH and was not extensive, particularly for Cd. EDTA appeared to enhance adsorption at low cadmium-to-carbon ratios. With more realistic loadings, when competition for surface sites is greatest, the presence of EDTA was detrimental to the process. 1,10-Phenanthroline was the more effective chelating ageat for promoting the removal of Cd. The uncomplexed Cd and Cd-EDTA systems were best described by the simple Langmuir adsorption isotherm. The adsorption of 1,10-phenanthroline and its Cd complex were modeled using a modified form of the Langmuir equation. (Author's abstract)
W88-07655

ORTHOPHOSPHATE REMOVAL FROM A SYNTHETIC WASTEWATER USING LIME, ALUM, AND FERRIC CHLORIDE,
Alabama Department of Environmental Management, Montgomery, AL 36104.
L. Sisk, L. Benefield, and B. Reed.
Separation Science and Technology SSTEDS, Vol. 22, No. 5, p 1471-1501, 1987. 15 fig, 5 tab, 12 ref.

Descriptors: *Orthophosphates, *Wastewater treatment, *Lime, *Alum, *Chlorides, *Iron, *Chemical coagulation, Performance evaluation, Heavy metals, Calcium, Phosphates, Hydrogen ion concentration, Aluminum, Carbonates, Regression analysis.

A series of jar tests was used to evaluate the effectiveness of lime, alum, and ferric chloride in precipitating orthophosphate from synthetic wastewaters. Calcium phosphate precipitation was most efficient at pH 11.0 and a total carbonate to phosphorus molar ratio of 15.0. A residual total orthophosphate concentration of 0.12 mg/L-P was observed for these conditions. The Mg:P molar ratio had little effect on orthophosphate removal from the synthetic wastewater. When alum was used, the minimum residual total orthophosphate concentration observed was 0.21 mg/L-P for an Al:P molar ratio of 3.0 and a pH of 6.0 when pH was adjusted before and during alum addition. When ferric chloride was used, an Fe:P molar ratio of 3.0 and a pH of 6.0 resulted in the lowest residual total orthophosphate concentration. This value was 0.19 mg/L-P when pH was adjusted before and during iron addition. A multiple regression analysis produced mathematical relationships which can be used to predict residual soluble and residual total orthophosphate concentration for lime, alum, and ferric chloride treatment. (Author's abstract)
W88-07656

NEW SEROVAR MOGDENI OF SEROGROUP TARASSOVI OF LEPTOSPIRA INTERROGANS ISOLATED FROM A SEWAGE PLANT IN ENGLAND,
Leptospira Reference Laboratory, Public Health Laboratory Service, Colindale, London, England.
For primary bibliographic entry see Field 5A.
W88-07666

SUSPENDED SOLIDS CARRY-OVER CONTROL IN BOTTOM ASH DEWATERING BINS,
Public Service Co. of New Mexico, Albuquerque.
For primary bibliographic entry see Field 5F.
W88-07677

SOLID-LIQUID SEPARATION BY MULTIMEDIA, CROSS-FLOW FILTRATION,
T.S. Associates, Inc., Columbia, MD.
T. R. Sundaram.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234852. Price codes: A03 in paper copy, A01 in microfiche. Technical Report J8512-1, July 1985. 35 p, 13 fig, 2 tab, 20 ref. NSF Grant No. CPE-8460558.

Descriptors: *Wastewater treatment, *Cross-flow filtration, *Separation techniques, *Filtration, *Solid-liquid separation, Deep-bed filtration, Filtration.

The separation of suspended and colloidal solids from dilute liquid suspensions is a necessary unit operation in many industrial and wastewater treatment processes, and is used in a wide variety of contexts. Such separation often requires methods other than conventional gravity settling. In conventional through-flow filtration two separate classes, namely surface (or 'cake') filtration and deep-bed filtration, can be identified. Filter matrices used in deep-bed filtration may range from commonly-available media such as diatomaceous earth, sand, and charcoal as well as a wide range of other commercially available ones, such as multiple layers of woven fabrics and screens, porous thermoplastics including foams, sintered metals (stainless steel and bronze), and porous ceramics. A study was conducted based on the thesis that a versatile class of in-depth filters can be developed, which when used appropriately in a CFF mode, can provide superior and cost-effective solid-liquid separation. This thesis was examined through small-scale, 'proof-of-concept', laboratory experiments on several types of specially-constructed in-depth filter elements. Since an understanding of certain phenomenological aspects of cross-flow, in-depth filtration of the type under consideration here is essential to place the experimental program and the results in the proper perspective, these aspects are first set forth, along with a discussion of the specific objectives of the study, in Section 2 of the report. The experimental method of approach is described in Section 3, while the research results are themselves presented in Section 4. The implications of the phase I results for the technical and economic feasibility of the proposed filtration technique are discussed in Section 5. Some concluding remarks are given in Section 6. (Lantz-PTT)
W88-07756

NEGATIVE-ION CHEMICAL IONIZATION MASS SPECTROMETRY AND AMES MUTAGENICITY TESTS OF GRANULAR ACTIVATED CARBON TREATED WASTE WATER,
Los Angeles County Sanitation Districts, Whittier, CA. San Jose Creek Water Quality Lab.
For primary bibliographic entry see Field 5A.
W88-07814

TECHNIQUES FOR THE FRACTIONATION AND IDENTIFICATION OF MUTAGENS PRODUCED BY WATER TREATMENT CHLORINATION,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5A.
W88-07815

USERS MANUAL FOR FLOOD EVACUATION PLANNING OF WATER AND WASTEWATER TREATMENT PLANTS,
Susquehanna River Basin Commission, Harrisburg, PA.
S. K. Wright.
Publication No. 87. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. November 1986. 60 p, 16 fig, 11 ref.

Descriptors: *Wastewater treatment facilities, *Water treatment facilities, *Flood planning, *Management planning, Flood damage, Susquehanna River, Flooding, Flood basins, Flood control, Risks.

The Susquehanna River Basin Commission, SRBC, has been concerned about the continuing vulnerability of water and wastewater treatment plants to flood damage for several years. A 1977 SRBC study of 237 wastewater treatment plants in the Susquehanna River Basin revealed that over 54% of these plants were subject to a 1% to 10% risk of being flooded each year. Many facilities were out of operation for several weeks to over a year following Tropical Storms Agnes in 1972 and Eloise in 1975. SRBC, in cooperation with the Pa. Dept. of Environmental Resources and the Corps of Engineers, participated in an Interagency Flood Damage Reduction Team Survey of six wastewater treatment plants in the Susquehanna River Basin. Reported on here is a summary of the flood vulnerability and effect of flooding during Tropical Storm Agnes in 1972 on these plants. (Lantz-PTT)
W88-07849

NON-CONVENTIONAL WATER RESOURCES USE IN DEVELOPING COUNTRIES.
For primary bibliographic entry see Field 3C.
W88-07850

OVERVIEW OF WATER REUSE FOR DEVELOPING COUNTRIES,
American Water Works Association Research Foundation, Denver, CO.
For primary bibliographic entry see Field 3C.
W88-07861

WASTE-WATER REUSE AND ITS APPLICATIONS IN WESTERN ASIA,
Economic and Social Commission for Western Asia (ESCWA), Baghdad (Iraq). Natural Resources, Science and Technology Div., Water Resources Section.
For primary bibliographic entry see Field 3C.
W88-07862

WASTE-WATER REUSE IN INDUSTRY,
Agence Financiere de Bassin Seine-Normandie, Paris (France).
For primary bibliographic entry see Field 3C.
W88-07863

INDONESIA: THE USE OF NON-CONVENTIONAL WATER RESOURCES,
Water Quality and Environmental Div., Inst. of Hydraulic Engineering, Ministry of Public Works, Jakarta (Indonesia).
For primary bibliographic entry see Field 3C.
W88-07877

DEGRADATION OF SUSPENDED PROTEINS IN AN ANAEROBIC ROTATING BED CONTACTOR,
Department of Biochemical Engineering, Delft University of Technology, Julianalaan 67, 2628 BC Delft, The Netherlands.
R. Douwenga, P. A. de Boks, and K. C. A. M. Luyben.
Biotechnology Letters BILED3, Vol. 10, No. 4, p 267-272, 1988. 2 fig, 3 tab, 9 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Proteins, *Industrial wastes, *Proteins, Solid wastes, Anaerobic digestion, Optimization, Hydrolysis, Liquid wastes, Contact beds, Brewery wastes, Hydrogen ion concentration.

Spent grain is a solid waste product of the brewing industry, continuing a high percentage (about 25% (w/w)) of proteins. In general, this waste is a valuable cattle feed, especially because of the proteins. In several places, however, the waste cannot be sold as cattle feed and causes serious problems after dumping, which is to a great extent caused by the putrefaction of proteins. This paper describes an anaerobic-stabilization process for the protein-rich portion of the spent grain. This portion, separated from the spent grains and containing mainly proteins, fat and carbohydrates, was digested in an Anaerobic Rotating Bed Contactor (AnRBC) at 37 C, pH = 7 and a hydraulic retention time of 1 hr. The hydrolysis and acidification of the suspension

was about 50% on an organic carbon basis at reactor loads of 2.5 kg TOC/cum/day (7.5 kg COD/cum/day). A further increase of the conversion rate seems quite possible with an improved reactor configuration. Further research is planned to determine the performance of an optimized AnRBC-reactor. (Friedmann-PTT)
W88-07955

EVALUATION OF THE TWO-ZONE WASTEWATER TREATMENT PROCESS AT NORRISTOWN, PENNSYLVANIA,
Borough of Norristown, City Hall, Airy and DeKalb Streets, Norristown, PA 19401.
S. R. Weech, V. T. Stack, and G. Orton.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234506. Price codes: A14 in paper copy, A01 in microfiche. August 1987. 333 p, 64 fig, 24 tab, 6 ref, 18 append. Cooperative Agreement No. CS807404.

Descriptors: *Activated sludge process, *Wastewater treatment, *Combined treatment, *Biological wastewater treatment, *Aerobic treatment, Clarifiers, Biomass, Oxygenation, Municipal wastewater, Economics, Pennsylvania, Biological oxygen demand.

Economic and practical considerations, such as limited land area for siting new or upgraded treatment facilities, compel today's designers to investigate alternatives to conventional strategies for wastewater treatment systems. One such alternative is the Two-Zone process as developed by Canadian Liquid Air Ltd. The Two-Zone process is a novel activated sludge process that combines the aerobic biological reactor and the clarifier in one tank for retrofit into existing plant tankage to increase capacity. A key feature of the Two-Zone process, which allows integration of the reactor and clarifier into a single tank, is the oxygenation of the recycled biomass with pure oxygen in an external transfer device. A 1,893 sq m/min (0.5 mgd) demonstration of the Two-Zone process was conducted at the Norristown Borough Municipal Wastewater Treatment plant in Pennsylvania. Objectives of the demonstration were to gain an insight into the functional requirements of the process and to test the system performance at higher loadings than attempted in previous studies. A basic conclusion of the demonstration was that the Two-Zone process functioned well by achieving up to 92% BOD5 removals at relatively low sludge ages (1 to 3 days) with average oxygen consumption of about 0.5 kd/kg BOD5 removed. (Author's abstract)
W88-07961

SINGLE-LABORATORY EVALUATION OF METHOD 8080 - ORGANOCHLORINE PESTICIDES AND PCBS,
Acurex Corporation, Mountain View, CA 94039.
For primary bibliographic entry see Field 5A.
W88-07962

ENVIRONMENTAL INFORMATION DOCUMENT: Y AREA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5E.
W88-07969

DOE HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM, ANNUAL REPORT: FY 1986,
Oak Ridge National Lab., TN. HAZWRAP Support Contractor Office.
For primary bibliographic entry see Field 5E.
W88-07971

WASTE ACID DETOXIFICATION AND RECLAMATION,
Battelle Pacific Northwest Labs., Richland, WA.
T. L. Stewart, J. N. Hartley, and E. G. Baker.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 51-77, 6 fig, 7 tab, 11 ref. DOE Contract No. DE-AC06-76RL0 1830.

Descriptors: *Metal-finishing wastes, *Wastewater treatment, *Detoxification, *Acids, Chemical treatment, Chemical precipitation, Industrial wastes, Uranium, Distillation, Zirconium, Sulfates, Copper, Nitrates.

Processes to reduce the volume, quantity, and toxicity of metal-bearing waste acid were demonstrated. Two precipitation processes and a distillation process are being used to minimize waste from fuel fabrication operations, which comprise a series of metal finishing operations. Waste process acids, such as HF-HNO3 etch solutions containing zirconium as a major metal impurity and HNO3 strip solution containing copper as a major metal impurity, are detoxified and reclaimed by concurrently precipitating heavy metals and regenerating acid for recycle. Results of precipitation tests conducted on a large bench scale in FY 1986 indicated that the volume of hazardous waste generated after implementation of these two waste-minimization processes will be 11 and 25% of the current waste volume for reclamation of the etch and strip solutions, respectively. Volume reduction is a strong economic incentive for implementation of these processes; payback periods of 1.4 and 3.3 years, have been estimated. Acid from a third waste acid stream generated from chemical milling operations will be reclaimed using distillation. This stream comprises HNO3 and H2SO4, containing uranium as the major metal impurity. Distillation allows NO3 to be displaced by SO4 in metal salts; free HNO3 is then vaporized from the uranium-bearing sulfate stream. Uranium can be recovered from the sulfate stream in a downstream concentration or a precipitation step. The technical feasibility of each of these options will be determined in FY 1987. However, based on preliminary economic estimates, the payback period for distillation with downstream concentration is 3.0 years; the payback period for distillation and neutralization is 5.9 years. (See also W88-07971) (Author's abstract)
W88-07972

SUPERCRITICAL WATER OXIDATION OF HAZARDOUS CHEMICAL WASTE,
Los Alamos National Lab., NM. Earth and Space Sciences Div.
C. K. Rofer.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 79-87.

Descriptors: *Wastewater treatment, *Supercritical water oxidation, *Chemical wastes, *Hazardous wastes, Industrial wastes, Oxidation, Organic compounds, Phase separation, Corrosion, Chemical reactions, Kinetics.

Oxidation in supercritical water (water at high enough temperatures and pressures that it exists in a single fluid phase with characteristics of both liquids and gases) can be used to convert hazardous organic compounds rapidly and completely to carbon dioxide, water, and other oxidation products such as salts. Reactions in supercritical water have only recently received attention, and a number of issues need to be resolved to develop scalable, operable, and economical cleanup processes. Key technical issues in developing and scaling a practicable process for appropriate Department of Energy Defense Programs (DP) wastes include phase separations, solubilities, corrosion and materials, mass transfer, and reaction mechanisms, including the roles of pyrolysis, hydrolysis, and oxidation in the chemical kinetics. A batch reactor has been designed, and experiments have been started in a plug-flow reactor. Future plans include definition of an appropriate DP waste stream and the engineering of a pilot plant for demonstration of the technology on that specific waste stream. (See also W88-07971) (Author's abstract)
W88-07973

HAZARDOUS PROCESS MATERIAL SUBSTITUTION,
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 5G.
W88-07975

IMPROVED TREATMENT/DISPOSAL OF REACTIVE METALS,
Argonne National Lab., IL.
D. R. Vissers.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 179-186, 3 fig.

Descriptors: *Sodium, *Wastewater treatment, *Waste disposal, *Metals, *Glass, *Leachates, Sodium, Silica, Costs.

A conceptual design is being developed for an integrated process to convert waste sodium to a stable form for disposal. There are two important considerations in determining acceptable waste forms for the sodium: (1) the chemical reactivity of the metal with environmental water (liquid or vapor), oxygen and carbon dioxide; and (2) the solubility of the sodium waste form, and leachability of its trace contaminants by, groundwater at the disposal site. Suitable glass compositions were investigated by a combination of literature review and experimental studies to determine the process conditions required for the sodium oxidation/glassmaking reaction system. The solid glassmaking materials (silica and perhaps other oxides) will be pneumatically conveyed to a cyclonic reactor; at the same time, the liquid sodium will be injected into the reactor by using a nitrogen aspiration system. This continuous cyclonic reactor will be maintained at the glassmaking temperature. Preliminary process energy calculations made for a sodium disilicate glass composition show that the reaction is exothermic and will provide enough energy to sustain the reactor temperature at the required 1000 to 1100 C. The process has been demonstrated and optimized in the laboratory and is ready for field demonstration. At the anticipated funding level of $25K for FY 1987, the program will involve only the completion of the conceptual integral design and preparation of a final report. Because of the very compact size of the system and high throughput rate (a 100-lb/h sodium throughput would utilize a cyclone reactor about as large as a coffee can), a demonstration could be performed relatively inexpensively. The total program could be completed in FY 1987 at a cost of about $300K. (See also W88-07971) (Lantz-PTT)
W88-07978

NITRIFICATION INHIBITION IN THE TREATMENT OF SEWAGE,
Thames Water, Reading (UK).
M. Richardson.
The Royal Society of Chemistry, Burlington House, London, W1V 0BN. 1985. 103 p.

Descriptors: *Wastewater treatment, *Nitrification, Ammonia, Nitrates, Chemical reactions, Chemical degradation, Literature review.

A rapid reference is provided to information on those chemicals which have been reported in the literature to produce inhibition of nitrification to sewage works processes. Some information is also included where chemicals are known to inhibit anaerobic processes. There are a number of incidences where loss of nitrification at a sewage treatment works has resulted in large concentrations of ammonia being discharged in the sewage works effluent; this has caused fish mortalities in the receiving waters and also put downstream potable water resources at risk. The final section of the book lists in ascending mass number the chemicals described in the earlier section. It can be of particular value when gas chromatography-mass spectrometry is undertaken on discharges, sewage, river or other water samples. (Lantz-PTT)
W88-07982

5E. Ultimate Disposal Of Wastes

SLUDGE INCREASES PULPWOOD PRODUCTION,
Wisconsin Univ.-Madison. Dept. of Soil Science.
J. G. Bockheim, T. C. Benzel, R. Lu, and D. A. Thiel.
Biocycle BCYCDK, Vol. 29, No. 3, p 57-59, March 1988. 3 tab, 3 ref.

Descriptors: *Sludge, *Primary sludge, *Land applications, *Pine trees, *Sludge disposal, *Pulp and paper industry, *Fertilizers, *Nitrogen, *Limiting nutrients, *Growth rates, Softwood, Wisconsin.

A 1:1 primary:secondary paper industry sludge was applied at rates of 32, 63, and 94 dry Mg/ha to a row-thinned, 27-year-old-red pine plantation in central Wisconsin. The mass and concentration of N in current needles were correlated ($p = 0.05$) with sludge application rate, particularly after the first growing season. Graphical diagnoses suggest that N was deficient on control plots and limiting to tree growth. Basal area and volume increments and cross-sectional area increment at the mid-stem position (7.8 m above ground level) were significantly greater on plots receiving a light application (32 Mg/ha) than for the other treatments. Sludge application depressed radial stem growth on plots receiving the high application (94 Mg/ha). Height growth was unaffected by sludge treatment. Although increased volume growth in subsequent years can't be ruled out, the depressed growth on plots receiving high levels of sludge was attributed to a reduction in apical dominance, resulting in increased allocation of dry matter to lateral branches and foliage at the expense of that in the stem. (Author's abstract)
W88-06843

ALLOCATION OF AQUIFER RESOURCES IN SCOTLAND,
British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, Scotland.
For primary bibliographic entry see Field 6B.
W88-06963

POLIOVIRUS RETENTION IN SOIL COLUMNS AFTER APPLICATION OF CHEMICAL- AND POLYELECTROLYTE-CONDITIONED DEWATERED SLUDGES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W88-07001

LOW-TEMPERATURE STABILITY OF VIRUSES IN SLUDGES,
Dept. of Civil and Environmental Engineering, Univ. of Cincinnati, Cincinnati, Ohio 45221.
For primary bibliographic entry see Field 5D.
W88-07026

SLUDGE DISPOSAL - DEVELOPMENTS IN ADVICE, TRAINING AND EQUIPMENT,
J. E. Hall.
European Water and Sewage, Vol. 91, No. 1094, p 147,149, April 1987.

Descriptors: *Waste disposal, *Sludge disposal, *Training, *Standards, *Information exchange, *Sludge utilization, *Land application, Soil injection, Agriculture, Fertilizers, Soil injection.

For the efficient utilization of sewage sludge on farmland, the water authorities require a range of sludge spreading equipment to meet specific operational conditions. It is important for the security of sludge spreading operations that such equipment is operated correctly to avoid damage to crops and soil, and that farmers are fully informed of the fertilizer and organic matter contents of this free manure. To meet these needs the Water Research Centre (WRc) has published a number of advisory booklets, based on operational experiences and research, which help water authorities and contractors provide an effective service to farmers. While it is important that farmers are properly informed of the value of the particular sludge that they receive, it is essential that the sludge is spread correctly to realize that value and that the water authorities or their contractors operate with the most cost-effective equipment for type of sludge, farming and soil conditions. The correct operation of most types of sludge spreading equipment is largely a matter of common sense and effective management. Soil injection is a cost-effective means of overcoming the odor and visual problems associated with surface spreading, particularly for undigested sludges, and while injection may be a viable treatment alternative to sludge digestion, an increasing number of water authorities now inject digested sludge to ensure the security of the disposal operation in particular situations. The practical implications of the research and operational experiences within the water industry have been drawn together into a code of practice on soil injection which is available free from WRc. Furthermore, a training course on soil injection has been set up by Silsoe College and WRc for water authority staff and contractors, to help ensure that the farmers receive an efficient and effective service. (Alexander-PTT)
W88-07055

REGIONAL HYDRODYNAMICS OF THE PROPOSED HIGH-LEVEL NUCLEAR-WASTE REPOSITORY SITES IN THE TEXAS PANHANDLE,
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W88-07112

CULTURE OF MARINE MICROALGAE WITH NATURAL BIODIGESTED RESOURCES,
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico). Div. of Oceanology.
J. Paniagua-Michel, B. C. Farfan, and F. Buckle-Ramirez.
Aquaculture AQCLAL, Vol. 64, No. 3, p 249-256, July 15, 1987. 3 fig, 3 tab, 31 ref.

Descriptors: *Organic wastes, *Wastes, *Algae, *Marine microalgae, *Aerobic digestion, *Inorganic compounds, Phosphorus, Nitrogen, Manure, Farm wastes, Mexico, Biological wastewater treatment.

The growth response of Pavlova (Monochrysis) lutheri (Droop) Green was assayed in a culture medium enriched with organic extracts aerobically digested from cow and chicken manures and from the macroalgae Macrocystis pyrifera (L.) C. Agard. The results indicate that with a traditional inorganic medium and elutriated, aerobically digested manures, it is possible to attain similar maximum algal densities and equivalent algal growth rates for similar time-periods despite large differences in inorganic nitrogen and phosphorus content. The cause for this is speculated to be the conversion of organic nitrogen and phosphorus in the manure to inorganic forms and the presence of growth stimulatory substances in the elutriate. (Author's abstract)
W88-07116

RECYCLING OF THE AQUATIC WEED, WATER HYACINTH, AND ANIMAL WASTES IN THE REARING OF INDIAN MAJOR CARPS,
Central Institute of Freshwater Aquaculture (ICAR), Kausalagang, Via: Bhubaneswar 751002, Orissa (India).
For primary bibliographic entry see Field 5D.
W88-07119

DDT DEGRADATION BY BACTERIA FROM ACTIVATED SLUDGE,
Department of Chemistry, Lady Irwin College, University of Delhi, Sikandra Road, New Delhi-110 001, India.
For primary bibliographic entry see Field 5D.
W88-07127

COMPARATIVE STUDY OF TIN PROFILES WITH OTHER METALS AND PHOSPHORUS PATTERNS IN LACUSTRINE SEDIMENTS: MOBILITY AND POLLUTION,
1 - Laboratoire de Chimie Analytique - Faculte des Sciences - Avenue de l'Universite, 64000 PAU - France.
For primary bibliographic entry see Field 5B.
W88-07135

COAGULATION AND SETTLING OF AEROBIC SEWAGE SLUDGE IN SEAWATER,
Delaware Univ., Newark. Coll. of Marine Studies.
W. A. Jenkins, and R. J. Gibbs.
Environmental Technology Letters ETLEDB, Vol. 8, No. 10, p 487-494, October 1987. 8 fig, 27 ref.

Descriptors: *Sludge disposal, *Ocean dumping *Aerobic sewage sludge, *Aerobic conditions, *Seawater, United States, Coagulation, Setling velocity.

The settling characteristics of aerobically treated sewage sludge from Middlesex, New Jersey were investigated. The data describe the rate of decrease in mass concentration for coagulating solids and subsequent settling rates in a column of seawater. Low turbulence values of 0, 2 and 4/sec an initial concentrations of 20 to 500 mg/l were used. The rate and extent of clearing is greater for larger initial concentrations. Mass concentration (Co) decreased at a rate of 4%Co/min for 500 mg/l initial concentration, but at only 0.5% 20 mg/l. Twenty to 40% of the initial mass concentration remained in suspension for an indefinite period of time. (Author's abstract)
W88-07151

POSSIBILITIES OF FEEDING DIETS FOR DUCKS USING ACTIVATED SLUDGE,
Department of Animal Physiology and Zoology, University of Agriculture, Prague, Czechoslovakia.
J. Cibulka, Z. Sova, P. Mader, D. Miholova, and V. Muzikar.
Environmental Technology Letters ETLEDB, Vol. 8, No. 12, p 669-672, December 1987. 1 fig, 3 tab, 3 ref.

Descriptors: *Sludge utilization, *Diets, *Lead, *Cadmium, *Ducks, Nutrition, Activated sludge, *Heavy metals, Trace metals, Bioaccumulation, Czechoslavakia, Tissue analysis.

The aim of the experiment was to test the possibility of feeding diets with the addition of 2.5% dried activated sewage sludge sterilized with different procedures. The results proved that lead and cadmium levels in all three types of duck tissue analyzed (liver, kidney, muscle) satisfied the existing hygienic limits (Pb, 0.5 for meat and 1.0 for organs; Cd, 0.05 for meat and 0.5 for organs). The sludge used for this experiment was supplied by the paper mill at Steti, CSSR and contained 16.65 mg Pb.kg and 2.03 mg Cd/kg. The possibility of supplementing feeding diets for ducks by adding 2.5% dried activated sewage sludge sterilized by either steam or irradiation was investigated in 320 Pekin White ducks. The ducks received the supplemented diet from birth to 56 days old, when they were sacrificed and their livers, kidneys, and breast muscle analyzed for cadmium and lead using atomic absorption spectrometry. (Miller-PTT)
W88-07160

EFFECTS OF SCRUBBER SLUDGE ON SOIL AND DREDGED SEDIMENT AGGREGATION AND POROSITY,
Illinois Univ., Urbana. Dept. of Agronomy.
K. R. Olson, and R. L. Jones.
Soil Science SOSCAK, Vol. 145, No. 1, p 63-69, January 1988. 7 tab, 26 ref.

Descriptors: *Sludge disposal, *Land disposal, *Spoil banks, *Soil aggregates, *Soil porosity, Chemical sludge, Topsoil, Soil water, Pore size, Soil absorption capacity, Retention capacity, Storage capacity, Transmissivity, Sudangrass.

In a greenhouse experiment, the effects of scrubber sludge on the aggregation and the porosity in various combinations of dredged sediments and topsoil in the presence of sudangrass roots were evaluated. As expected, the water-stable aggregates increase with increasing percentage of topsoil. For all combinations, scrubber sludge decreased aggregation. The topsoil had a total porosity similar to the sediments at the completion of the study in the absence of scrubber sludge. The total

porosity increased with additional quantities of scrubber sludge for all combination of topsoil and sediments. Transmission (>50 micron), water storage (50 to 0.5 micron), and residual (<0.5 micron) pore volumes differed substantially between the sediments and topsoil, as well as with scrubber sludge treatments. The sediments had a higher water retention difference than the topsoil. The presence of scrubber sludge had little effect on topsoil, but reduced the water storage volumes for the sediments. With scrubber sludge addition, the residual pore volumes remained high for topsoil, but decreased substantially for sediments. For all combinations of topsoil and sediments, scrubber sludge dramatically increased transmission porosity. This increase in transmission pores within the sediments with scrubber sludge additions resulted in a higher rate of saturated flow of water than for the sediments without scrubber sludge. The pore-size distributions were estimated by water-release methods and verified by directly measuring soil pore-size distributions by Hg-intrusion porosimetry. (Author's abstract)
W88-07173

EFFECTS OF THE APPLICATION OF WASTEWATER FROM OLIVE PROCESSING ON SOIL NITROGEN TRANSFORMATION,
Departamento de Quimica Agricola. Estacion Experimental del Zaidin (C.S.I.C.), Granada, Apdo. 119, Spain.
J. D. Perez, and F. Gallardo-Lara.
Communications in Soil Science and Plant Analysis CSOSA2, Vol. 18, No. 9, p 1031-1039, 1987. 3 fig, 15 ref. CSIC (Spain) Project ID-286.

Descriptors: *Wastewater disposal, *Land disposal, *Food-processing wastes, *Oily water, *Vegetation water, *Soil chemistry, *Nitrification, Fertilization, Nitrogen compounds, Nitrates, Ammonium compounds, Calcareous soils, Oil industry, By-products.

'Vegetation water' is the name given to wastewater remaining after the industrial extraction of olive oil. This foul-smelling runoff creates serious waste disposal problems for olive-oil producing industries wherever olives are extensively cultivated. One possible solution is to employ vegetation water as fertilizer. An incubation experiment was performed to study the effects of vegetation water on nitrogen transformation in a calcareous soil. The application of this wastewater was decreased nitrate formation in comparison with control assays during approximately the first half of the experimental period (6 weeks). Results were similar although more marked when vegetation water plus ammoniacal nitrogen was applied as opposed to ammoniacal nitrogen alone. The incorporation of vegetation water during the initial phases of study also reduced soil nitrogen-ammonium levels both when residue-only treatments were compared with controls and when vegetation water plus ammoniacal nitrogen treatments were compared with ammoniacal nitrogen only. The vegetation water investigated causes a transient inhibition of nitrogen availability, a factor which must be kept in mind when considering the possible use of wastewater from olive processing as fertilizer even if complemented with ammoniacal fertilizers. Assimilable forms of the latter cannot be expected to become available to plants until at least a period of approximately four weeks has elapsed. (Shidler-PTT)
W88-07182

BEHAVIOR OF VARIOUS SOLUTES IN A FIELD SOIL: SIX YEARS OBSERVATION,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
T. Kuboi, and S. Otoma.
Journal of Hydrology JHYDA7, Vol. 95, No. 1/2, p 97-111, 15 November 1987. 10 fig, 4 tab, 10 ref.

Descriptors: *Solutes, *Soil chemistry, *Cultivated lands, *Sludge, *Land disposal, *Nutrients, *Volcanic ash, Soil solution, Ions, Nitrates, Chlorides, Bicarbonates, Sulfates, Calcium, Magnesium, Sodium, Potassium, Hydrogen ion concentration, Eggplant, Sorghum, Wheat, Ryegrass.

Soil solution was sampled over a period of six years at various depths (10, 20, 35, 50, 65, 80, and 95 cm) of a light-colored Andosol originating from volcanic ash. Three plots were established in the experimental field: (1) an unfertilized bare (BN) plot, untreated except for surface tillage; (2) a bare (BS) plot, treated with limed sewage sludge; and (3) a cultivated (PS) plot, also treated with sludge. The sludge was applied to the soil as a 0-12 cm layer at a rate of 15 tons/ha/yr in June or July each of the first five years. The cropping sequence on the PS plot was: eggplant-sorghum-wheat (1980-1982); eggplant-wheat (1983); and Italian ryegrass (1984-1985). Most of the wheat roots were localized in the upper 20 cm zone. Three porous ceramic cups were inserted at each sampling depth on each plot, and the soil solution was sampled by suction of 0.8-0.93 bar for 6-20 h. Nitrate, Cl, Ca, and Mg concentrations at a depth of more than 35 cm in the BS plot began to increase after the fourth sludge application. The levels of nitrate, chloride, calcium, magnesium, sodium, and potassium were lower in the PS plot than in the BS plot, but bicarbonate and sulfate levels and pH were lower in the BS plot. (Author's abstract)
W88-07195

COPPER(II) COMPLEXES WITH REFRACTORY ANIONIC SURFACTANTS FOUND IN SEWAGE SLUDGE,
Istituto di Chimica Agraria, Universita di Bari, Via G. Amendola 165/A, 70125 Bari, Italy.
N. Senesi, and G. Sposito.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 1/2, p 147-155, September 1987. 4 fig, 1 tab, 13 ref. Department of the Interior Matching Grant B-212-CAL and University of California Water Resources Center Project UCAL-WRC-W-583.

Descriptors: *Metal complexes, *Copper, *Copper compounds, *Surfactants, *Sludge, Molecular structure, Chemical composition, Spectral analysis, Fulvic acids, Anaerobic digestion, Biodegradation, Land disposal, Sulfonates, Esters, Anisotropy, Physicochemical properties.

Electron spin resonance spectrometry was used to study Cu(II) complexes with anionic surfactant compounds of the types that have been detected in sewage sludge or in the fulvic acid fraction of anaerobically-digested sewage sludge and found to resist biodegradation in the soil environment. The electron spin resonance spectra of frozen (77 degrees K), aqueous solutions of linear alkyl benzene sulfonates and fatty alcohol sulfate esters at Cu-ligand molar ratios ranging from 0.1 to 1 exhibited anisotropic patterns indicative of a groundstate of Cu(II) bound into innersphere complexes with the ligands arranged in square planar coordination. Sulfonate-type surfactants, both in the acid and salt forms, appeared to complex Cu(II) more efficiently than ester sulfate-type surfactants. Conventional physical parameters calculated from the electron spin resonance spectra were consistent with fully oxygenated, 4 O-ligand binding sites for the Cu(II) ions and indicated the formation of similar unidentate or bidentate complexes between Cu(II) and the surfactants at any Cu/ligand molar ratio investigated. The spectral lineshapes and related parameters of the Cu(II)-anionic surfactant complexes, however, were not very similar to those observed previously for Cu(II)-sewage sludge fulvic acid complexes. It is concluded that anionic surfactants involved in Cu(II) complexation by sewage sludge or sewage fulvic acid do not behave as isolated, independent ligands, but instead may participate as co-ligands with other O-containing functional groups and/or as moities incorporated into the fulvic acid structure. (Author's abstract)
W88-07267

BIOECONOMIC CONSIDERATIONS FOR WASTEWATER REUSE IN AGRICULTURAL PRODUCTION,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3C.
W88-07271

OVERVIEW OF LANDFILL BOTTOM LINER HYDRAULICS,
Department of Civil Engineering, University of Patra, Patra, Greece.
A. C. Demetracopoulos.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 49-56, February 1988. 15 fig, 12 ref.

Descriptors: *Landfills, *Bottom linings, *Mathematical models, *Solid waste disposal, Leachate, Simulation, Drainage, Hydraulic conductivity, Design criteria, Design flow.

Landfill bottom liners are important elements in the analysis and design of solid waste disposal facilities. This study presents an overview of several models, describing the flow over and through liners. The examined models are compared against data from a laboratory investigation. A quasi-steady state (QSS) and a transient (TS) model yield the most complete description of linear hydraulics, and allow for estimation of the system's collection efficiency. The TS model performed slightly better than the QSS model, although the latter has the advantage of simplicity. The hydraulic conductivities of the liner and the drainage layer and the leachate accretion rates are parameters whose magnitudes must be known with relative accuracy for good evaluation of system performance. (Author's abstract)
W88-07277

REUSE OF STABILIZATION POND EFFLUENT FOR CITRUS RETICULATA (ORANGE), FOREST AND ROAD VERGE PLANTS,
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 3C.
W88-07358

ALUMINUM RECLAMATION BY ACIDIC EXTRACTION OF ALUMINUM-ANODIZING SLUDGES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
F. M. Saunders, and R. C. Shaw.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 369-378, March 1988. 6 fig, 7 tab, 7 ref. EPA Cooperative Agreement CR810290-01-0.

Descriptors: *Wastewater reclamation, *Aluminum, *Industrial wastewater, *Metal-finishing wastes, *Sludge reclamation, *Waste recovery.

Extraction of aluminum-anodizing sludges with sulfuric acid was examined to determine the potential for production of commercial-strength solutions of aluminum sulfate, that is, liquid alum. The research established kinetic and stoichiometric relationships and evaluated product quality. Detailed material-balance data were collected to monitor the progress and extent of extractions. The production of a commercial-strength liquid alum was feasible. Issues relative to product quality indicate that segregation of certain metal containing wastes may be required for selected aluminum-finishing wastes. (Author's abstract)
W88-07422

SHORELINE IMPACT FROM OCEAN WASTE DISCHARGES,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Hydraulics and Water Resources.
R. C. Y. Koh.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 4, p 361-376, April 1988. 10 fig, 1 tab, 9 ref. NOAA Grant NA80RAD00055.

Descriptors: *Ocean dumping, *Wastewater disposal, *Water pollution sources, *Shoreline impact, Advection, Water currents, Simulation analysis, Monte Carlo method.

A methodology which permits estimation of the advective transport probabilities from a coastal wastewater discharge based on information that can be obtained from current measurements. Shoreline impact can be assessed, and the tendency for background buildup and benthic accumulation estimated. The method utilizes measured data to obtain parameter values to allow synthetic currents

to be generated that can in turn be used in a Monte Carlo scheme for obtaining the advective transport probabilities. The method permits enhancement and improvement of the estimates when the amount and extent of data coverage are expanded. (Author's abstract)
W88-07429

INDUCED AERATION WINDROW COMPOSTING OF RAW SLUDGES,
J. Wren-Jarvis.
Biocycle BCYCDK, Vol. 29, No. 4, p 48-52, April 1988. 3 fig, 1 tab, 4 ref.

Descriptors: *Sludge disposal, *Composting, *Secondary wastewater treatement, *Primary wastewater treatment, *Primary sludge, Project planning, Windrow composting, Organic wastes, Aeration, Administrative regulations, Nevada, Economic aspects, Sludge digestion.

The Sanitation District of Clark County, Las Vegas, Nevada, has experienced continued difficulty with the disposal of raw sludges generated from primary and secondary wastewater treatment plant processes since the early 1960s. A fully comprehensive sludge management plan had never been prepared for this district, so a study was conducted to prepare such a plan. The findings of this study, conducted to investigate a long-range, cost-effective and reliable method of handling raw wastewater treatment plant sludges, and to address concerns with the long-term reliability of the existing landfill operation and with the forthcoming federal sludge management programs and regulations are reported. It was recommended that the district proceed with plans for anaerobic digesters and a full-scale windrow composting facility for digested secondary sludge, and that the design of a full-scale facility be preceded by a small-scale windrow composting demonstration project utilizing raw organic sludges to address questions of odor potential and product quality. It was concluded that raw sludges conditioned with lime and ferric chloride prior to filter press dewatering can be successfully composted in aerated windrows, and that raw sludges conditioned with polymers prior to dewatering tend to produce a more odorous filter cake, which can be successfully composted with carefully monitored and controlled aeration rates. (Friedmann-PTT)
W88-07506

WATER SUPPLY AND SLUDGE METALS,
Wright-Pierce, Topsham, ME.
W. E. Brown.
Biocycle BCYCDK, Vol. 29, No. 4, p 59-62, April 1988. 4 fig, 4 tab, 10 ref.

Descriptors: *Sludge disposal, *Land disposal, *Metals, *Drinking water, Heavy metals, Copper, Zinc, Lead, Cadmium, Corrosion, Critical concentration, Industrial wastewater.

Ultimate sludge disposal is one of the major tasks facing wastewater treatment facilities. Land application is often the most economical method, especially where adequate farmland exists nearby. However, metal concentrations in the sludge either limit the site life or the application rate to the point where land application is not economical. When metals are above regulatory limits, land application may become impossible. To determine what concentration of metals in the drinking water would cause the metal levels in sewage sludge to exceed the allowable land application limits, one must determine the maximum allowable sludge metal limits, the fraction of metals removed by the sludge, and the amount of sewage sludge produced per unit volume of drinking water. The critical concentrations of four metals, copper, zinc, lead, and cadmium, i.e., the allowable land application level, were compared with actual metal concentrations. Sludge metal levels were analyzed at treatment facilities that have no significant industrial source of metals and are served by corrosive water supplies. With this information, one can determine the metal concentrations in the drinking water that will cause the metal levels in the sewage sludge to exceed the critical concentration. If water supply system metal levels are above the critical concentration, there could be a cost impact on sludge disposal. (Friedmann-PTT)
W88-07507

SOME INTERMEDIATES IN THE WET AIR OXIDATION OF PHENANTHRENE ADSORBED ON POWDERED ACTIVATED CARBON,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5F.
W88-07545

SURVEY OF MUNICIPAL ANAEROBIC SLUDGE DIGESTERS AND DIAGNOSTIC ACTIVITY ASSAYS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5D.
W88-07549

MICROCLIMATE AND ACTUAL EVAPOTRANSPIRATION IN A HUMID COASTAL-PLAIN ENVIRONMENT,
Geological Survey, Columbia, SC. Water Resources Div.
K. F. Dennehy, and P. B. McMahon.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 295-312, September 15, 1987. 8 fig, 2 tab, 13 ref.

Descriptors: *Radioactive wastes, *Radiation, *Underground waste disposal, *Evapotranspiration, *Microclimates, *Humid climates, Microclimatology, Meteorological variables, Wastes, Soil temperature, Air temperature, Wind speed, South Carolina, U.S.A.

Continuous hourly measurements of twelve meteorologic variables recorded during 1983 and 1984 were used to examine the microclimate and actual evapotranspiration at a low-level radioactive-waste burial site near Barnwell, South Carolina. The study area is in the Atlantic Coastal Plain of southwestern South Carolina. Monthly, daily, and hourly trends in net radiation, incoming and reflected short-wave radiation, incoming and emitted long-wave radiation, soil-heat flux, dry- and wet-bulb temperatures, soil temperatures, wind direction and speed, and precipitation were used to characterize the microclimate. Average daily air temperatures ranged from -9 to 32 degrees C during the period of study. Net radiation varied from about -27 to 251 watts per m and was dominated by incoming short-wave radiation throughout the year. The peak net radiation during a summer day generally occurred 2-3h before the peak vapor pressure deficit. In the winter, these peaks occurred at about the same time of day. Monthly precipitation varied from 15 to 241 mm. The Bowen ratio method was used to estimate hourly evapotranspiration, which was summed to also give daily and monthly evapotranspiration. Actual evapotranspiration varied from 0.0 to 0.7 mm per hour , 0.8-5 mm per d, and 20-140 mm per month during 1983 and 1984. The maximum rate of evapotranspiration generally occurred at the same time of day as maximum net radiation, suggesting net radiation was the main driving force for evapotranspiration. Precipitation exceeded evapotranspiration during 14 months of the 2 yr study period. Late fall, winter, and early spring contained the majority of these months. The maximum excess precipitation was 115 mm in February 1983. (Author's abstract)
W88-07565

POTENTIAL USE OF THE DEEP AQUIFERS IN THE NEGEV DESERT, ISRAEL - A CONCEPTUAL MODEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 3C.
W88-07580

TRACE METALS AND CHLORINATED HYDROCARBONS IN SEWAGE SLUDGES OF KUWAIT,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
O. Samhan, and F. Ghobrial.
Water, Air, and Soil Pollution WAPLAC, Vol. 36, No. 3/4, p 239-246, December 1987. 3 tab, 17 ref.

Descriptors: *Sludge disposal, *Waste disposal, *Path of pollutants, *Poly chlorinated biphenyls, *Land disposal, *Pollutant identification, *Wastewater analysis, *Heavy metals, *Chlorinated hydrocarbons, *Kuwait, Wastewater treatment, Water treatment facilities, Organic compounds, Zinc, Lead, Nickel, Mercury, Silfler, Pesticides, Halogenated pesticides, Detection limits, Wastewater.

Levels of trace metals and chlorinated hydrocarbons were determined in sludge produced at the three main wastewater treatment plants in Kuwait (Ardhiya, Jahra, and Reqqa). Over the 6 mo study period (October 1984 to March 1985) levels at the three plants showed the following ranges (micrograms/g dry weight); Cd, 0.5 to 5.0; Cu, 90 to 270; Zn, 1100 to 3000; Pb, 80 to 300; Ni, 25 to 60; Hg, 1.8 to 3.6; Ag, 1 to 35; PCBs, 0.1 to 3.6; lindane, 0.4 to 7.4; sigma DDT (i.e., DDT +DDD + DDE), 0.07 to 0.20; aldrin, below detection to 0.07; endrin, below detection to 0.27; dieldrin, 0.005 to 0.04). Mean levels were generally close or lower than mean concentration limits for application of sludge on agricultural land, which is one of the most cost-effective and attractive techniques for sludge disposal. For Kuwait to adopt this application, however, the characteristics of the local soil and prevailing environmental conditions, notably the frequent occurrence of severe dust storms, should be considered. (Author's abstract)
W88-07616

LARGEST COMPOSTING SYSTEM TAKES ORDERS FROM PC,
Department of Environmental Services, Portland, Oregon.
E. Appel, and G. Hettman.
Water Engineering and Management WENMD2, Vol. 135, No. 1, p 41-43, January, 1988.

Descriptors: *Computers, *Automation, *Composting, *Wastewater facilities, *Sludge disposal, *Process control, Portland, Oregon, Oxygenation, Sludge digestion, Biodegradation, Digestion, Sludge utilization.

The first totally enclosed, in-vessel composting facility in the U.S. is producing a revenue-generating soil-amending product closely resembling peatmoss. The facility, located in Portland, Oregon, is believed to be the largest of its type in the world. Since design of the plant rendered automation imperative, the facility is operated by a Model 584 programmable controller (PC)from Gould Industrial Automation Systems of North Andover, MA. The hardware offers the capacity and speed to handle the composter's analog control loops, and has the ability to interact directly with both signal and power voltage circuits. The control arrangement permits both manual and automatic operation of equipment. On automatic, one push of a button will initiate all functions for a selected transfer. When a transfer is complete, the PC times out the shutdown of outfeed equipment and conveyors in reverse order to ensure that the outfeed screw and belts are empty when stopped. If the belt of any conveyor slips during transfer, a sensor monitoring the head pulley stops the transfer and sounds an alarm. Other details of the composting and control system are discussed. (Doria-PTT)
W88-07650

DATA REPORT ON STATIC LEACH TESTS WITH SAVANNAH RIVER LABORATORY DEFENSE WASTE GLASS IN PBB1 BRINE AT 90 C,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-07750

INVESTIGATION OF SLURRY CUTOFF WALL DESIGN AND CONSTRUCTION METHODS FOR CONTAINING HAZARDOUS WASTES,

Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
R. M. McCandless, and A. Bodocsi.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-229688. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/2-87/063, August 1987. 191 p, 47 fig, 12 tab, 46 ref, 4 append. EPA Contract No. 68-03-3210.

Descriptors: Hydraulic structures, *Slurry cutoff walls, *Waste disposal, *Hazardous wastes, Hydraulic design, Model studies, Cutoffs, Hydraulic gradient, Permeability coefficient.

Specific technical design standards for soil-bentonite slurry trench cutoff walls used to isolate hazardous wastes have not been established. A review of current design and construction methods was performed to summarize current engineering practice, identifying areas of technical debate, and initiate necessary research to promote the development of rational standards. The review of current methods was followed by laboratory studies using experimental test equipment to study selected components of model cutoff walls. An instrumented slurry test column was developed and used to investigate the hydraulic characteristics and importance of bentonite slurry seals formed on the walls of the cutoff trench during construction. Also, a slurry wall tank capable of accomodating a 508 mm (20 inch) diameter, 101.6 mm (4 inch) thick circular cutoff wall was used to evaluate the effects of overburden pressure (vertical consolidation) and hydraulic gradient (horizontal consolidation), and to evaluate the potential for self-remediation of hydraulic defects ('windows' through the barrier) via in situ consolidation of the soil-bentonite backfill. Three model cutoff walls were constructed and tested in the slurry wall tank. Testing of the first wall principally served to identify needed modifications in equipment and test procedures. The second model wall was permeated with water under three hydraulic gradients for each of three different vertical surcharge pressures. The tests served to demonstrate that both overburden pressure and hydraulic gradient have significant and comparable effects on reducing the average conductivity of the wall. The third model wall was intentionally breached by two small slot-like 'windows' representing small pockets of entrapped bentonite slurry in the backfill immediately after construction. By incrementing surcharge pressure it was possible to 'heal' the windows as evidenced by a return to the predetermined baseline hydraulic conductivity of the wall. This suggests that in situ consolidation of the backfill may serve to eliminate hydraulic defects in the form of pockets of slurry or micro-cracks related to chemical degradation. (Lantz-PTT)
W88-07751

MARINE ECOLOGICAL CONSEQUENCES OF WASTE DISPOSAL,
Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 5C.
W88-07752

STREAM SAMPLING FOR WASTE LOAD ALLOCATION APPLICATIONS,
Tetra Tech, Inc., Lafayette, CA.
W. B. Mills, G. L. Bowie, T. M. Grieb, K. M. Johnson, and R. C. Whittemore.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234753. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/625/6-86/013. Handbook, September 1986. 57 p, 31 fig, 17 tab, 58 ref, append.

Descriptors: *Waste load, *Streams, *Water quality management, *Management planning, *Waste disposal, *Handbooks, *Model studies, Water sampling, Effluents, Toxicity, Fate of pollutants, Rivers, Streamflow, Water quality, Sampling.

Sampling requirements in support of waste load allocation (WLA) studies in rivers and streams are discussed. Two approaches to waste load allocation are addressed: the chemical-specific approach and the whole effluent approach. Numerical or analytical toxicant fate models were used to implement the chemical-specific approach. Modeling requirements and sampling guidelines are delineated for this method. For the whole effluent approach, the method is first summarized and then instream dye study requirements are presented. The report concludes with example applications of the chemical-specific approach for conventional and toxic pollutants. The primary purpose of this handbook is to help water quality specialists design stream surveys to support modeling applications for waste load allocations. The planner is guided through the data collection process so that models used for WLA can be calibrated, verified, and applied to the critical design conditions. Field sampling requirements of the whole effluent approach to waste load allocation are also addressed. The second purpose of this handbook is to show how models can be used to help design stream surveys. Since the models will eventually be used to predict the allowable waste loads, they can be set up and applied before the stream surveys are finished. The third purpose of this handbook is to educate field personnel on the relationship between sampling requirements and modeling requirements. (Lantz-PTT)
W88-07753

QUARTERLY BRINE MIGRATION DATA REPORT, APRIL-JUNE 1984: NUCLEAR WASTE REPOSITORY SIMULATION EXPERIMENTS (BRINE MIGRATION), ASSE MINE OF THE FEDERAL REPUBLIC OF GERMANY,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
J. L. Eckert, A. J. Coyle, and H. N. Kalia.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011694. Price codes: A13 in paper copy, A01 in microfiche. Technical Report No. BMI/ONWI-643, June 1987. 250 p, 124 fig, 92 tab, 1 ref. DOE Contract No. DE-AC02-83CH10140.

Descriptors: *Brines, *Asse Mine, *West Germany, *Path of pollutants, *Radioactive waste disposal, *Waste disposal, *Salt mines, Boreholes, Temperature, Salt water, Data collections, Data acquisition, Geohydrology.

This is the fourth report in a series of ten data reports prepared by staff members of the Engineering Department of the Office of Nuclear Waste Isolation (ONWI) on data received from nuclear waste simulation experiments conducted in the Asse Salt Mine in the Federal Republic of Germany (FRG). Data was obtained between May 24, 1983, and June 30, 1984. The purpose of the report is to provide field test data for various analysts and to refine and support numerical models on brine migration, room closure, and other thermomechanical behaviors of salt subjected to heat and gamma radiation. Test data for the first 13 months of operations on brine migration rates, borehole pressure, salt temperatures, and thermomechanical behavior of the salt are included. The Asse Data Acquisition System (DAS) is used to collect data on a 24-hour basis. The data are recorded on magnetic tapes, which are sent to ONWI. The data that are not recorded on magnetic tapes are collected manually on a daily or weekly basis. This includes the measurements for brine collection, room closure, and salt pressures from flat cells. The data are presented in tabular and graphic form. The graphs include all the data, whereas the tables present only weekly or monthly readings to keep the list short. (Lantz-PTT)
W88-07759

ACCELERATED LEACH TEST(S) PROGRAM: ANNUAL REPORT,
Brookhaven National Lab., Upton, NY. Dept. of Nuclear Energy.
R. Doty, and J. Heiser.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-012307. Price codes: A06 in paper copy, A01 in microfiche. Report No. BNL--52042, September 1986. 164 p, 117 fig, 23 tab, 82 ref. DOE Contract No. DE-AC02-76CH00016.

Descriptors: *Path of pollutants, *Leaching, *Radioactive waste disposal, *Waste disposal, *Tracers, Portland cements, Bitumen, Vinyl ester-styrene, Cesium radioisotopes, Strontium radioisotopes, Cobalt radioisotopes, Materials testing, Potassium, Calcium, Strontium, Aluminum, Silicon, Sodium, Model studies.

Work performed for the Accelerated Leach Test(s) Program at Brookhaven National Laboratory in Fiscal Year 1986 under the sponsorship of the U.S. DOE's Low-Level Waste Management Program (LLWMP) was concentrated in the following areas: (1) A computerized database of LLW leaching data has been developed; and (2) Long-term tests on portland cement, bitumen and vinyl ester-styrene (VES) polymer waste forms containing simulated wastes are underway which are designed to identify and evaluate factors that accelerate leaching without changing the mechanisms. Although much of the work in this program is ongoing, results allow several preliminary conclusions to be made: (1) Formulation development, indicated that waste loading effects are of great significance in determining waste form stability toward immersion. Leaching studies on waste forms incorporating simulated wastes indicated that waste loading significantly affects the leaching behavior for all systems tested. Model validation analysis indicated that, in both bitumen and VES incorporating soluble salts, leaching behavior is controlled by waste loading effects; (2) Baseline leaching studies on waste forms composed of the pure solidification agents, portland cement, bitumen and vinyl ester-styrene, doped with radiotracers of Cs, Sr and Co have been completed; (3) Correlation matrix analysis of leaching releases of Cs-137 and Sr-85 radiotracers and elemental releases of cement components including Na, K, Ca, Sr, Al and Si indicate no correlation between the radiotracer leaching and the cement component leaching; (4) Solid phase analysis of cement before and after leaching indicates that both the physical structure and elemental chemical composition of the cement has changed due to leaching; (5) Solid phase analysis of VES/aqueous waste emulsion waste forms show that the waste is contained in a polymer structure which is sponge-like in appearance; and (6) Leaching of cement waste forms incorporating sodium sulfate resulted in reactions between the waste and cement. (Lantz-PTT)
W88-07774

HEALTH ASPECTS OF WASTE-WATER REUSE FOR IRRIGATION OF CROPS,
Pan American Health Organization (PAHO), Washington, DC. Environmental Health Program.
For primary bibliographic entry see Field 3C.
W88-07865

CASE STUDY FOR CONTROL OF BORON POLLUTION,
State Planning Organization, Sectoral Programming Dept., Ankara (Turkey).
For primary bibliographic entry see Field 5C.
W88-07869

LAND APPLICATION OF SLUDGE: FOOD CHAIN IMPLICATIONS.
Lewis Publishers, Inc., Chelsea, Michigan. 1987. 168 p. Edited by A. L. Page, T. J. Logan and J. A. Ryan.

Discriptors: *Sludge disposal, *Land application, *Land disposal, *Path of pollutants, *Food chains, *Trace elements, Heavy metals, Bioaccumulation, Soil contamination, Degradation, Leaching, Water pollution effects, Organic compounds, Crop production, Municipal wastes, Trace metals, Public health.

The U.S. Environmental Protection Agency in cooperation with the University of California, Riverside, and the Ohio State University, Columbus, sponsored a workshop on the 'Effects of Sewage Sludge Quality and Soil Properties on Plant Uptake of Sludge-Applied Trace Constituents' in November 1985. This book presents the findings of the workshop which brought together 31 scientists to critically examine available published and unpublished information and produce an assessment

of the current knowledge about factors known to affect the impact of trace constituents on crops and consumers when applied to lands in the form of municipal sludge. The six chapters in this book cover the following: an introduction to the problems associated with applying municipal sludge to agricultural lands; the effects of soil properties on accumulation of trace elements by crops; the effects of sludge properties on accumulation of trace elements by crops; the effects of long-term sludge application on accumulation of trace elements by crops; the transfer of sludge-applied trace elements to the food chain; and the effects of trace organics in sewage sludges on soil-plant systems and their riskto humans. (See W88-07905 thru W88-07909) W88-07904

EFFECTS OF SOIL PROPERTIES ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 5B.
W88-07905

EFFECTS OF SLUDGE PROPERTIES ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W88-07906

EFFECTS OF LONG-TERM SLUDGE APPLICATION ON ACCUMULATION OF TRACE ELEMENTS BY CROPS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-07907

TRANSFER OF SLUDGE-APPLIED TRACE ELEMENTS TO THE FOOD CHAIN,
For primary bibliographic entry see Field 5B.
W88-07908

EFFECTS OF TRACE ORGANICS IN SEWAGE SLUDGES ON SOIL-PLANT SYSTEMS AND ASSESSING THEIR RISK TO HUMANS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5C.
W88-07909

GROUNDWATER AND AQUIFERS: AN OVERVIEW OF 'EXOTIC' USES,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 4B.
W88-07910

MATHEMATICAL MODELLING OF RADIONUCLIDE MIGRATION IN GROUNDWATER,
Theoretical Physics Division, Atomic Energy Research Establishment, Harwell, Oxfordshire, UK.
A. W. Herbert, D. P. Hodgkinson, D. A. Lever, J. Rae, and P. C. Robinson.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 2, p 199-120, 1986. 7 fig, 33 ref.

Descriptors: *Model studies, *Path of pollutants, *Waste disposal, *Groundwater movement, *Mathematical models, *Radioactive waste disposal, *Fracture permeability, Rocks, Radionuclide migration, Hydrodynamic dispersion, High permeability fracture zones, Diffusion, Network models, Geologic fractures.

This paper reviews recent work on the development of mathematical models for the transport of radionuclides in flowing groundwater. These models have an important role to play in assessing the long-term safety of radioactive waste burial, and in planning and interpretation of associated experiments. Firstly, general multi-dimensional numerical models for the flow of water and the transport of dissolved radionuclides through permeable media are described. Their use in assessing the importance of possible transport pathways is illustrated by examples of flow in rocks with high permeability fracture zones. Secondly, recent advances in the description of flow and transport through fractured rock masses are considered. The results of field experiments are used to examine the characteristics of single fractures such as transmissivity, the proportion taking flow and the diffusion of ions into the surrounding rock. In addition, network models are used to examine the connectivity, flow and hydrodynamic dispersion through fracture systems and to assess how well transport can be modeled by an equivalent permeable medium model. The fracture systems are defined by probability distributions for the orientations, lengths and hydraulic apertures of fractures together with information about the number of fractures per unit volume. Providing the region size is much bigger than the mean fracture length, the permeability is constant, but that hydrodynamic dispersion is not adequately modeled by a diffusion-like term. (Author's abstract)
W88-07911

INTERACTIONS OF CO57, SR85 AND CS137 WITH PEAT UNDER ACIDIC PRECIPITATION CONDITIONS,
Pittsburgh Univ., PA. Graduate School of Public Health.
For primary bibliographic entry see Field 5B.
W88-07944

DEGRADATION OF SUSPENDED PROTEINS IN AN ANAEROBIC ROTATING BED CONTACTOR,
Department of Biochemical Engineering, Delft University of Technology, Julianalaan 67, 2628 BC Delft, The Netherlands.
For primary bibliographic entry see Field 5D.
W88-07955

WASTE MIGRATION IN SHALLOW BURIAL SITES UNDER SATURATED FLOW CONDITIONS,
Georgia Inst. of Tech., Atlanta. Nuclear Engineering and Health Physics Program.
For primary bibliographic entry see Field 5B.
W88-07964

ENVIRONMENTAL INFORMATION DOCUMENT: Y AREA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
J. R. Cook, and M. W. Grant.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011240. Price codes: A18 in paper copy, A01 in microfiche. Report No. DPST--85-856, December 1986. 403 p, 21 fig, 51 tab, 10 ref, 6 append.

Descriptors: *Waste disposal, *Waste storage, *Waste management, *Waste treatment, *Radioactive waste disposal, *Environmental impact, *Site selection, Solidification, Grout, Environmental protection, Wells, Aquifers, Groundwater quality, Fate of pollutants, Drinking water, Groundwater pollution, Wetlands, Savannah River.

Operational alternatives are presented for a new waste storage/disposal facility, to be designated Y Area, for effluent treatment concentrates and incinerator ash at the Savannah River Plant. Alternatives are presented for siting, facility design, treatment of waste, storage and/or disposal, and closure. The information was used to develop the environmental consequences of the alternatives and to estimate costs. Three candidate sites meet performance criteria for storage/disposal operations. The sites are: Site L (100 acres SW of F Area), site B (300 acres NE of H Area), and contiguous sites P and Q (240 and 255 acres, respectively, south of the 700 U TC Area). Storage or disposal facility options that can be used for different operational alternatives are: Greater Confinement Disposal, above or below ground storage or disposal vaults, and above grade operation. Two general process descriptions are given. One of these uses waste solidified in a grout mixture similar to the saltstone process. The other process containerizes dry waste, salts and ash, into packages with structural properties, such as reinforced concrete boxes. Environmental monitoring requirements, closure alternatives, and site suitability for the different storage and disposal alternatives also are given. Long-term performance of the operational alternatives described above is discussed. For each case concentrations of contaminants (both radioactive and nonradioactive) in the water from a well at the boundary of the facility, in the wetlands where the aquifer discharges into Upper Three Runs Creek, in Upper Three Runs Creek, and in the Savannah River have been estimated. These concentrations are compared to a set of surface water criteria based on drinking water standards and ecological considerations. (Lantz-PTT)
W88-07969

DOE HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM, ANNUAL REPORT: FY 1986,
Oak Ridge National Lab., TN. HAZWRAP Support Contractor Office.
L. D. Eyman.
Available from the National Technical Information Service, Springfield, VA. 22161,as DE87-011968. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/HWP--25, May 1987. 193 p.

Descriptors: *Hazardous wastes, *Waste management, *Management planning, Technology transfer, Information systems, Administration.

The basic objective of the Department of Energy (DOE) Hazardous Waste Remedial Actions Program (HAZWRAP) is to develop and promote an integrated approach to Defense Programs (DP) installation compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA), which conserves DP resources for its primary missions while providing a technically sound and socially acceptable response that satisfies involved regulatory agencies. The goal of the HAZWRAP Support Contractor Office (SCO) is to assist DOE in achieving this objective by implementing program control, analysis, and information transfer functions and supporting the implementation and assimilation of Technology Adaptation (TA) and activities by other DOE contractors. During FY 1986, significant progress was made in all areas. The activities of HAZWRAP for the past fiscal year were organized into seven principal areas: technical analysis and technology transfer; regulatory analysis; strategic planning; information systems; program administration; technology adaptation; and technology demonstration. (See W88-07972 thru W88-07978)(Lantz-PTT)
W88-07971

RISK ASSESSMENT OF HAZARDOUS WASTES,
Sandia National Labs., Albuquerque, NM. Waste Management Systems Div. 6431.
R. P. Rechard.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 89-102, 2 fig, 9 ref.

Descriptors: *Chemical wastes, *Risk assessment, *Hazardous wastes, *Waste disposal, Environmental protection, Ranking, Disposal sites, Model studies.

In FY 1986 Sandia National Laboratories, (SNL), completed two subtasks for Risk Assessment/Evaluation for Hazardous Chemical Wastes: (1) an evaluation of current schemes for ranking waste sites and the state of the art in assessing risk at waste sites; and (2) the development of a new site ranking system (SRS) for the Department of Energy (DOE) hazardous waste sites. Numerous ranking schemes were reviewed and three evaluated in detail under subtask 1. The evaluation describes areas deficient in the three ranking schemes and recommends specific improvements for a ranking scheme for DOE sites. The state-of-the-art review of risk assessment examined the main com-

ponents of the consequence modeling (source term, geosphere transport, exposure pathway, and dose effects models) to help in developing the comprehensive risk assessment methodology. The SRS, developed by SNLA under subtask 2, has its basis in an assessment of health risks at a site. This logical basis in risk methodology tends to reduce the distortion of the results found in other ranking schemes. The clear logic of SRS helps ensure the successful application of the ranking procedure and increases its versatility when modifications are necessary for unique situations. (See also W88-07971) (Author's abstract)
W88-07974

HAZARDOUS PROCESS MATERIAL SUBSTITUTION,
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 5G.
W88-07975

IMPROVED TREATMENT/DISPOSAL OF REACTIVE METALS,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5D.
W88-07978

5F. Water Treatment and Quality Alteration

CITRUS PROCESSING WASTEWATER TREATMENT,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
For primary bibliographic entry see Field 5D.
W88-06824

UTILIZATION OF SURFACE WATER FOR DRINKING PURPOSES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Biology.
W. T. Sedgwick.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 3, p 232-251, September 1987.

Descriptors: *History, *Drinking water, *Surface water, *Riparian waters, *Water quality standards, *Water supply, Filtration, Water treatment, Bacteria, Epidemics.

This is an 1890 discussion of a paper by W. H. Lindley of Frankfort Germany. The paper discussed is a summary of certain reports and results presented at the Paris Exposition and concerned the utilization of river-waters. At this time there appeared to be marked changes in public opinion and in the opinion of engineers on the standards applied to drinking waters. Problems such as abundance, purity, utilization of rivers, filtration and purification, and bacteria are discussed. (VerNooy-PTT)
W88-06829

SELECTION OF SANDS FOR A FILTER,
A. Hazen.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 3, p 252-257, September 1987.

Descriptors: *History, *Filtration, *Sand, *Sand filters, Hydraulic conductivity, Glacial drift, Drinking water, Riparian waters, Particle size.

This article was originally published in 1892. The author was asked by Mr. Mills, the consulting engineer building the Lawrence, Massachusetts, filter, to take charge of getting out the sand for the filter. Several problems, such as size of the sand and uniformity of sand particles obtained, were examined. The source of sand is aglacial deposit that varies in character throughout its extent. Calculations from siftings and micrometer measurements were used to determine the particle size of the sand. It was found that frictional resistance was inversely proportional to the square of the size of the smaller sand grains. Data from experiments made it possible to predict frictional resistance from sand properties without having to conduct tests. (VerNooy-PTT)
W88-06830

FILTER OF THE WATER SUPPLY OF THE CITY OF LAWRENCE, AND ITS RESULTS,
H. F. Mills.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 3, p 258-279, September 1987. 3 fig.

Descriptors: *History, *Filtration, *Sand filters, *Design criteria, *Bacteria, *Drinking water, Water quality, Municipal water, Riparian waters.

This article was originally published in 1894. The Lawrence, Massachusetts, Pumping Station is by the side of the Merrimack River, above the city and about 1,000 feet upstream from the nearest house. In 1892, in view of the possibility of cholera making it necessary to cut off the Lawrence water supply, the city government made an appropriation for beginning the work of constructing the filter in accordance with the advice of the State Board of Health and under its direction. A description of the construction of the filter and its effect upon the bacteria of the water applied to it is made. (VerNooy-PTT)
W88-06831

RELATIVE APPLICABILITY OF SAND AND MECHANICAL FILTERS,
Cincinnati Water Works, OH.
G. W. Fuller.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 3, p 280-304, September 1987.

Descriptors: *History, *Filtration, *Sand filters, *Mechanical filters, *Bacteria, *Clarification, *Turbidity, *Alum, Drinking water, Water quality, Municipal water, Riparian waters, Aluminam sulfate, Costs Coagulation.

This discussion was first published in 1899. Mechanical filters with sufficient sulfate of alumina quantities are able to effect very fair bacterial purification, but sand filters are decidedly superior in these respects, and are also more economical where the raw water is not too turbid and other conditions are favorable. Sand filters are able to completely clarify moderately turbid waters, but with the most turbid waters, they are inadequate. For such waters satisfactory work can only be obtained with the use of some form of coagulant, and water so coagulated may be applied to either sand or mechanical filters. (VerNooy-PTT)
W88-06832

DISINFECTION AS AN ADJUNCT TO WATER PURIFICATION,
H. W. Clark, and S. D. Gage.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 3, p 305-328, September 1987. 7 tab.

Descriptors: *History, *Bacteria, *Disinfection, *Oxidation, *Chlorination, *Chemical treatment, *Water treatment, Drinking water, Sterilization, Water quality, Permanganates, Hypochlorites, Stream pollution.

This is a reprint of a speech read in 1909. Of the many disinfectants tested, the copper salts, the permanganates, and the hypochlorites are the only ones which have shown any promise of usefulness in water purification, and it is with the last two that this paper has to deal. A complete sterilization of a highly polluted water of the character of the Merrimack River cannot be obtained by the use of either permanganate of potash or bleaching powder, except by the use of extremely large amounts. By the use of permanganate in the proportion of 0.5 part per 100,000, or of bleach in the proportion of 0.1 part per 100,000, a reduction in total bacteria amounting to about 99 per cent may be obtained. (VerNooy-PTT)
W88-06833

WATERBORNE NON-A, NON-B HEPATITIS,
Fogarty International Center, National Institutes of Health, Bethesda, MD.
For primary bibliographic entry see Field 5C.
W88-06846

BACTERIOLOGICAL CONTAMINATION OF WATER IN RURAL AREAS: AN INTERVENTION STUDY FROM MALAWI.
Dept. of Pediatrics, Linkoping University Hospital, S-581 85 Linkoping, Sweden.
For primary bibliographic entry see Field 5G.
W88-06847

MUTAGENIC AND CLASTOGENIC PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE: A POTENT BACTERIAL MUTAGEN IN DRINKING WATER,
Toxicology and Microbiology Division, Health Effects Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio.
For primary bibliographic entry see Field 5C.
W88-06964

FACTORS PROMOTING SURVIVAL OF BACTERIA IN CHLORINATED WATER SUPPLIES,
American Water Works Service Co., Inc., Belleville Lab., 1115 South Illinois Street, Belleville, Illinois 62220.
M. W. LeChevallier, C. D. Cawthon, and R. G. Lee.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 649-654, March 1988. 4 fig, 3 tab, 39 ref.

Descriptors: *Water treatment, *Disinfection, *Chlorination, Microbiological studies, Bacterial physiology, Microorganisms, Biofilms.

The attachment of bacteria to surfaces provides the greatest increase in disinfection resistance. Attachment of unencapsulated Klebsiella pneumoniae grown in medium with high levels of nutrients to glass microscope slides afforded the microorganisms as much as a 150-fold increase in disinfection resistance. Other mechanisms which increased disinfection resistance included the age of the biofilm, bacterial encapsulation, and previous growth conditions (e.g., growth medium and growth temperature). These factors increased resistance to chlorine from 2- to 10-fold. The choice of disinfectant residual influence the type of resistance mechanism observed. Disinfection by free chlorine was affected by surfaces, age of the biofilm, encapsulation, and nutrient effects. Disinfection by monochloramine, however, was only affected by surfaces. These resistance mechanisms were multiplicative (i.e., the resistance provided by one mechanism could be multiplied by the resistance provided by a second mechanism), which could account for the survival of bacteria in highly chlorinated water supplies. (Alexander-PTT)
W88-07018

EFFECTS OF THREE OXIDIZING BIOCIDES ON LEGIONELLA PNEUMOPHILA SEROGROUP 1,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
E. L. Domingue, R. L. Tyndall, W. R. Mayberry, and O. C. Pancorbo.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 741-747, March 1988. 4 fig, 2 tab, 39 ref.

Descriptors: *Hydrogen peroxide, *Water treatment, *Cooling towers, *Disinfection, *Ozonation, *Chlorination, *Legionella, *Biocides, Microorganisms, Microbiological studies, Water quality, Bactericides, Oxidation.

A study was conducted to determine the bactericidal effects of ozone and hydrogen peroxide relative to that of free chlorine on Legionella pneumophila serogroup 1. In laboratory batch-type experiments, organisms seeded at various densities were exposed to different concentrations of these bio-

cides in demand-free buffers. Bactericidal effects were measured by determining the ability of L. pneumophila to grow on buffered charcoal-yeast extract agar supplemented with a-ketoglutarate. Ozone was the most potent of the three biocides, with a > 99% kill of L. pneumophila occurring during a 5-min exposure to 0.10 to 0.30 micrograms of O3 per ml. The bactericidal action of O3 was markedly affected by changes in pH or temperature. Concentrations of 0.30 and 0.40 micrograms of free chlorine per ml killed 99% of the L. pneumophila after 30- and 5-min exposures, respectively. A 30-min exposure to 1,000 micrograms of H2O2 per ml was required to effect 99% reduction of the viable L. pneumophila population. However, no viable L. pneumophila could be detected after a 24-h exposure to 100 or 300 micrograms of H2O2 per ml. Attempts were made to correlate the biocidal effects of O2 and H2O2 with the oxidation of L. pneumophila fatty acids. These tests indicated that certain biocidal concentrations of O3 and H2O2 resulted in a loss or severe reduction of L. pneumophila unsaturated fatty acids. (Author's abstract)
W88-07022

ENSURING THE SECURITY OF PUBLIC WATER SUPPLIES,
Brown and Caldwell, Consulting Engineers, 2300 Oakmont Way, Suite 100, Eugene, OR 97401.
P. J. Ownbey, F. D. Schaumburg, and P. C. Klingeman.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 30-34, February 1988. 2 fig, 2 tab, 20 ref.

Descriptors: *Security, *Water conveyance, *Training, Design standards, Design criteria, Regulatory agencies, Public utility districts, Municipal water.

Accidental spills, vandalism, and acts of terrorism have become a growing threat to the safety and security of public water utilities in the United States and abroad. Adequate plans to safeguard supplies include design of facilities with security as a priority and training personnel to recognize and correct potential breaches in security. Two municipal water supply systems in the Pacific Northwest were evaluated in this study to determine the degree of safety and security provided to discourage, detect, and counteract accidental or intentional contamination of their raw and treated water. One is a groundwater system; the other is supplied by surface water. The findings will help increase awareness of the problems confronting utility personnel, regulatory agencies, and design engineers. (Author's abstract)
W88-07034

SELECTING OPTIMAL PIPE SIZES FOR WATER DISTRIBUTION SYSTEMS,
Systems Planning Div. of the Austin, Texas, Water and Wastewater Utility.
T. M. Walski, J. Gessler, and J. W. Sjostrom.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 35-39, February 1988. 2 fig, 2 tab, 20 ref.

Descriptors: *Water supply systems, *Computer programs, *Optimization, *Pipelines, Computers, Design standards, Design criteria, Engineering.

In spite of the fact that computers are taking over increasing amounts of the engineer's computational work, selecting pipe sizes for water distribution systems remains a process based on rules of thumb and trial and error. Computerized procedures for sizing distribution system pipe are becoming available, but acceptance is limited because few optimization models are available as user-friendly tools that can be easily applied by engineers. A computer program was developed that follows the conventional trial-and-error approach to pipe sizing. Instead of sizing for every pipe in the system, the program sizes projects made up of groups of pipes. The program further reduces the number of combinations by only solving for commercially available in versions that run on large computers or on IBM PC's. (Alexander-PTT)
W88-07035

SURFACE WATER SUPPLIES AND HEALTH,
Epidemiology and Statistics Section, Microbiology and Hazard Assessment Branch, Toxicology and Microbiology Div., US Environmental Protection Agency, 26 W. Martin Luther King Dr., Cincinnati, OH 45268.
G. F. Craun.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 40-52, February 1988. 8 fig, 10 tab, 55 ref.

Descriptors: *Chlorination, *Water treatment, *Water conveyance, Population exposure, Epidemiology, *Drinking water, *Public health, Statistical methods, Human diseases, Chlorinated hydrocarbons.

Rivers, streams, lakes, and reservoirs have long been important sources of drinking water. In the past, these sources were often heavily contaminated by sewage discharges and, unfortunately, were also important in the transmission of communicable diseases such as typhoid and cholera. With improvements in sewage disposal practices, development and protection of water sources, and water treatment, outbreaks of waterborne disease are less frequently reported, and drinking water becomes a less important route of transmission of communicable disease. In the United States, the incidence of waterborne disease is low but waterborne outbreaks continue to occur. In the 1971-1985 period, 123 outbreaks of waterborne disease were attributed to contamined, untreated surfaced water or inadequately treated surface water. Most of these outbreaks were in small community and noncommunity water systems. The use of chlorine as a disinfectant in water treatment facilities can lead to the formation of trihalomethanes. Epidemiologic studies have implicated chlorinated drinking water in the development of colon and bladder cancer and cardiovascular disease. (Alexander-PTT)
W88-07036

OCCURRENCE AND SIGNIFICANCE OF CRYPTOSPORIDIUM IN WATER,
Arizona Univ., Tucson. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W88-07037

REMOVAL OF HEPATITIS A VIRUS AND ROTAVIRUS BY DRINKING WATER TREATMENT,
Baylor College of Medicine, One Baylor Plaza, Houston, TX 77030.
V. C. Rao, J. M. Symons, A. Ling, P. Wang, and T. G. Metcalf.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 59-67, February 1988. 5 fig, 9 tab, 44 ref. EPA Cooperative Agreement CR 811081.

Descriptors: *Water treatment, *Viruses, *Drinking water, *Coagulation, *Filtration, Turbidity, Hydrogen ion concentration, Settling, Human disease, Alkalinity.

The removal of hepatitis A virus (HAV) and rotavirus (RV) from source water was studied by laboratory and pilot-scale treatment, including coagulation, filtration, and softening. Poliovirus (PV) was included as a frame of reference because considerable data are available on the removal of this virus during treatment. It is concluded that coagulation and flocculation remove HAV and RV as effectively as PV, with turbidity and alkalinity having no influence on the extent of removal. In addition, all three viruses were efficiently removed during Ca(2+) and Mg(2+) hardness reduction at pH 11. Coagulation, settling, and filtration in a pilot plant lowered the densities of HAV, RV, and PV by 98.4-99.7%. (Author's abstract)
W88-07038

REMOVING GIARDIA CYSTS AND OTHER PARTICLES FROM LOW TURBIDITY WATERS USING DUAL-STAGE FILTRATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. B. Horn, D. W. Hendricks, J. M. Scanlan, L. T. Rozelle, and W. C. Trnka.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 68-77, February 1988. 12 fig, 3 tab, 14 ref.

Descriptors: *Water treatment, *Filtration, *Coliforms, *Dual-stage filtration, *Giardia, Turbidity, Chemical treatment, Bacteria, Colorado.

Dual-stage filtration (DSF) in packaged form is an alternative to conventional rapid-rate filtration for small utilities. The effectiveness of DSF for removing Giardia cysts from low turbidity (<1 ntu), low temperature (near 0 deg C) water was tested. Removals of total coliform bacteria and turbidity were also determined. Two different water sources in Colorado (Horsetooth Reservoir with a turbidity of 4 ntu and the Cache Poudre River with a turbidity of < 1 ntu) were tested, with runs up to 35 h in length. Dual-stage filtration removed >99 percent of Giardia cysts from waters with a turbidity of <1 ntu and a temperature of <8 deg C, when proper chemical treatment was applied and the system was operated at 10 gpm/sq ft (6.8 mm/s) or less. Removal of total coliform bacteria exceeded 98%, and removal of turbidity exceeded 90%. (Alexander-PTT)
W88-07039

ENVIRONMENTAL ASPECTS OF LEGIONNAIRES' DISEASE,
Veterans Administration Medical Center, Pittsburgh, PA. Special Pathogens Section.
P. W. Muraca, V. L. Yu, and J. E. Stout.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 78-86, February 1988. 9 fig, 79 ref.

Descriptors: *Water treatment, *Legionella, *Public health, Chlorination, Ozonation, Cooling towers, Water conveyance, Human diseases, Population exposure, Epidemiology, Disinfection.

The clinical symptoms of legionnaires' disease are reviewed, the natural and man-made habitats of Legionella pneumophila are described, and various disinfection methods are evaluated. Although heat rejection devices (cooling towers and evaporative condensers) have been linked to outbreaks of legionnaires' disease, recent evidence suggests that potable water distribution systems are the primary reservoirs of L. pneumophila. Inhalation of aerosols containing the organism, instillation of the organism into the lung via medical maneuvers of the respiratory tract, and aspiration of contaminated water into the lung are the most likely modes of transmission of L. pneumophila. Treatment methodologies include hyperchlorination, thermal eradication, ozonation, and ultraviolet light irradiation. (Author's abstract)
W88-07040

INVESTIGATION OF LEGIONELLA PNEUMOPHILA IN DRINKING WATER,
Groundwater Management and Supply Branch, USEPA, John F. Kennedy Federal Building, Boston, MA 02203.
L. E. Witherell, R. W. Duncan, K. M. Stone, L. J. Stratton, and L. Orciari.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 2, p 87-93, February 1988. 5 fig, 2 tab, 56 ref. EPA Cooperative Agreement CR-810360.

Descriptors: *Water conveyance, *Analytical methods, *Pollutant identification, *Water analysis, *Legionella, *Public health, *Drinking water, Domestic water, Epidemiology, Plumbing.

An investigation of Legionella pneumophila in drinking water systems and home plumbing appurtenances was conducted in two phases. In phase 1, 68 water samples for L. pneumophila analysis were collected from hot and cold kitchen sink faucets in homes on 17 community water systems. No L. pneumophila organisms were isolated from any of these samples. However, the relatively small sample size, the many variables in the sampling procedure, and potential limitations of the laboratory detection techniques employed may have contributed to the failure of significant recovery. In

phase 1A, the kitchen sink faucets and aerators, showerheads, and supply pipes were sampled with sterile swabs, and samples of hot water were collected from the drains of water heaters in each home. A total of 184 samples was collected from homes on four community water systems. In addition, two samples were collected from a home with a shallow dug well. During this phase, L. pneumophila organisms were recovered from two water heater flush samples - one from a home on a community water system and the other from the home with the shallow well. Both of the positive samples were taken from electric, nonrecirculating water heaters. This finding, together with the lack of recovery in the home water distribution plumbing, could indicate that L. pneumophila may be transported from natural aquatic sources via drinking water systems in very low levels to home water heaters, in which the organisms may increase to detectable levels. (Author's abstract)
W88-07041

SCHEMATIC MODELS FOR DISTRIBUTION SYSTEMS DESIGN. I: COMBINATION CONCEPT,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
D. Hamberg, and U. Shamir.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 129-140, March 1988. 3 fig, 2 tab, 10 ref.

Descriptors: *Model studies, *Water conveyance, *Design criteria, *Design standards, *Mathematical studies, Economic aspects, Engineering, Pipelines.

Schematic models for use in preliminary design of water distribution systems are developed by two approaches: (1) A step-wise combination of elements; and (b) a nonlinear continuum representation of the system as a whole. The objective is to create models that are equivalent to a detailed network model in terms of the computed distributions of heads and flows over the area, yet are much more efficient, and therefore enhance the engineering-economic analysis. The step-wise combination method has been developed beyond existing procedures to consider more complex arrangements of pipes as well as water withdrawals, which vary along the pipes and with time. (See also W88-07043) (Author's abstract)
W88-07042

SCHEMATIC MODELS FOR DISTRIBUTION SYSTEMS DESIGN. II: CONTINUUM APPROACH,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
D. Hamberg, and U. Shamir.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 141-162, March 1988. 13 fig, 11 ref.

Descriptors: *Model studies, *Water conveyance, *Design criteria, *Planning, *Mathematical studies, Economic aspects, Engineering, Pipelines, Jerusalem.

An approach which views the water distribution system as a nonlinear horizontal continuum was proposed. An areally distributed conductance, a function of pipe properties and areal density, is the link between a potential function, which is related to the heads and the flow field. The model can be used to obtain the flow field of an existing system for a prescribed potential, or to optimize the conductance of a planned system for a given distribution of demands and specified boundary conditions. The method is demonstrated by a case study, for the city of Jerusalem, Israel. This approach, including models and computer programs, was specifically developed to carry out a detailed analysis of an existing of planned system. The approach is designed to result in better planning by permitting consideration of a broad range of alternatives using small, simplified models. (See also W88-07042) (Alexander-PTT)
W88-07043

METROPOLITAN WATER MARKET DEVELOPMENT: SEATTLE, WASHINGTON, 1887-1987,
California Univ., Davis. Dept. of Civil Engineering.
J. R. Lund.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 223-236, March 1988. 2 fig, 3 tab, 34 ref.

Descriptors: *Metropolitan water management, *Planning, *Water management, *Seattle, *Market development, *Water supply development, Water law, Water demand, Wastewater facilities.

In many metropolitan areas it is common for a large central city to sell water to many of its surrounding suburban communities. In the Seattle, Washington metropolitan region, the city (population 494,000) provides water to 34 suburban cities and water districts with a total population of roughly 596,000. The development of this water market has its origins in the geographic pattern of metropolitan population and institutional development, water law, the economies of scale of water production, and the economic scarcity of clean, inexpensive water sources. Management and long-range planning for such a system are reviewed and the advantages and disadvantages of this market system for Seattle and its customers discussed. The de facto regionalization of the metropolitan water supply is contrasted with the de jure regionalization of metropolitan Seattle's wastewater system, which is managed jointly by the region's governments. (Author's abstract)
W88-07045

JOINT RESERVOIR AND AQUEDUCT DESIGN AND OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
L. E. Flynn, and M. A. Marino.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 179-196, March 1988. 4 fig, 3 tab, 21 ref. ARS Cooperative Agreement 4116-H.

Descriptors: *Water conveyance, *Benefits, *Planning, *Model studies, *Mathematical studies, *Reservoirs, *Aqueducts, *Design criteria, *Design standards, Economic aspects, Water delivery.

Numerical quadrature methods were used to solve the integral equations for steady-state reservoir-storage density functions. The resulting approximations were used in a variety of problems with particular emphasis on the joint optimization of the design and operation of reservoirs and water delivery systems. Basic examples, to illustrate the use of the methods, expose several interesting economic tradeoffs present in reservoir operation, and factors affecting these tradeoffs were categorized. More involved examples show the interdependence of target deliveries, delivery capacities, and the probabilistic nature of the water supplies in joint optimization problems. The continuous approximations from the quadrature methods were used in nonlinear optimization programs, jointly with a probabilistic delivery system model, to determine the partition of storage between interyearly and intrayearly uses to maximize the expected benefits from the corresponding optimally designed and operated delivery system. (Author's abstract)
W88-07047

MODELING WATER QUALITY IN DISTRIBUTION SYSTEMS,
RMM Technical Services, Inc., Cincinnati, OH.
R. M. Maes, W. M. Grayman, and R. M. Clark.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 197-209, March 1988. 8 fig, 6 ref.

Descriptors: *Water conveyance, *Water quality, *Model studies, *Mathematical studies, Spatial distribution, Hydrodynamics, Water delivery, Hydraulic properties.

Water quality although acceptable when it leaves the treatment plant may deteriorate before it reaches the user. Changes in quality may be caused by chemical or biological transformations, by a loss of system integrity, or by blending of waters from different sources. Until recently, little attention has been paid to the problem of changes in water quality in the distribution system. A sequential steady-state approach to modeling water quality in distribution systems was applied and the results compared to field data. The field data showed significant spatial and temporal water quality variation in the distribution system. The sequential steady-state solutions provided a reasonable representation of changes in water quality with time. It is concluded that an understanding of the hydraulic flow patterns and directions that create gradients of concentrations is extremely important in interpreting quality modeling results. Field quality data is important in developing, verifying, and understanding predictive models. Such quality data should be at time intervals sufficient to reflect changes in system dynamics. (Author's abstract)
W88-07048

REPLACEMENT OF SAND BY GRANULAR ACTIVATED CARBON IN RAPID GRAVITY SAND FILTERS,
M. T. Kleij.
European Water and Sewage, Vol. 91, No. 1091, p 16, January 1987.

Descriptors: *Activated carbon, *Rapid sand filtration, *Backwash, *Cost-benefit analysis, Performance evaluation, Flow rates, Water quality standards, Water quality, Surface water, Potable water.

When surface water, rather than groundwater, is used for potable water production, it generally requires more extensive treatment. One of the standard techniques for water purification is rapid sand filtration, a system having the disadvantages of high capital cost relative to capacity, and relatively poor operating economics, through high backwash water consumption. The replacement of sand with activated carbon is discussed as a means of increasing water production capacity while decreasing backwash water consumption. Parallel tests on dual media (sand-activated carbon) filters, and conventional rapid gravity sand filters, have proven the superior filtration properties and efficiency of the dual media filter. The hydraulic properties of dual media filers yield apparent flow rates that are some 2.5 times greater than those of conventional rapid gravity sand filters. Backwash water consumption for dual media filters is only 1.4 per cent, compared with 2.5 per cent for rapid gravity sand filters. Conversion makes it possible to meet taste and odor specifications. Flow rates can be increased. Potable water plants can be upgraded at relatively low cost (only the activated carbon) to produce higher quality potable water. (Alexander-PTT)
W88-07057

CONTRACTUAL OPERATION AND MAINTENANCE SERVICES FOR EFFICIENT AND COST EFFECTIVE MANAGEMENT OF UTILITY SERVICES AND INDUSTRIAL PLANTS,
T. G. Temperley.
European Water and Sewage, Vol. 91, No. 1091, p 35-36, January 1987.

Descriptors: *Water treatment facilities, *Management planning, *Operations and maintenance, *Cost-benefit analysis, *Contracts, Efficiency, Training, Economic aspects, Management, Utilities, Services.

As plant and equipment increase in age, plant efficiency decreases; while maintenance requirements increase out of all proportion to earlier historical experience, demanding higher standards of maintenance and more capable, experienced and qualified personnel. The professional Operation and Maintenance contractor is well experienced in operating such plant. His staff includes maintenance personnel who are available on an as required basis to solve intransigent and complex problems. Because the costs of such expertise is shared by a number of contracts the cost of such a service is economically attractive and does not distort the operating costs as would be the case if the plant owner employed a person of this caliber on a full time basis. The productivity and plant

performance required throughout the term of the contract is usually referenced in the scope of work. This may be determined by the manufacturer's design figures or by a performance test carried out prior to hand over of the plant to the contractor. The contractor is required to provide a complete range of insurance cover for the plant and personnel. Management, Operation and Maintenance Contracts are usually of three to five years duration. A contract of less than three years tends to be expensive because amortization of capital equipment used on the contract in less than three years is costly. In the case of water production and distribution authorities, power generation facilities, oil refineries, hospitals, hotels, industrial plants, etc, the management, operation and maintenance of the plant and equipment are no longer a distracting and frustrating problem to the general management of the facility. Their effective time can be allocated completely to the main purpose of the facility, safe in the knowledge that the plant and equipment are being operated in an optimum manner by a professional team of experienced personnel under, and at predetermined fixed costs and productivity. Management, Operation and Maintenance Services offer a viable and effective means of providing a cost effective service to the public. (Alexander-PTT)
W88-07059

REMOVAL AND RECOVERY OF HEAVY METALS BY ION EXCHANGE FIBER,
Dept. of Chemical Engineering, Nagoya Univ., Nagoya 464.
For primary bibliographic entry see Field 5D.
W88-07060

OZONATION OF ORGANIC REFRACTORY COMPOUNDS IN WATER IN COMBINATION WITH UV RADIATION,
Kyushu Univ., Fukuoka (Japan). Dept. of Applied Chemistry.
K. Ikemizu, M. Orita, M. Sagiike, S. Morooka, and Y. Kato.
Journal of Chemical Engineering of Japan JCEJAQ, Vol. 20, No. 4, p 369-374, 1987. 11 fig, 19 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Ozonation, *Performance evaluation, *Organic compounds, *Ultraviolet light, Organic carbon, Acids, Radicals, Degradation.

The ozonation rates of organic refractory compounds such as aliphatic carboxylic acids and alcohols were determined in water at 293 K. The experiment was carried out by recirculating a solution between an ozone absorption column and a rectangular ozone/UV reactor, and the time-dependent changes in concentration of organic substances were directly measured. In the presence of UV radiation of about 30 W/sq m, the initial ozonation rate of organic substances was increased by 10-10,000 times. The total organic carbon was effectively decreased in the presence of UV radiation. This was explained by the destruction of acetic and oxalic acid hydroxyl radicals which were produced in the ozone/UV system. The ozone/UV oxidation rate of acetic and oxalic acid was roughly proportional to the degree of dissociation. (Author's abstract)
W88-07061

EPIDEMIC GIARDIASIS CAUSED BY A CONTAMINATED PUBLIC WATER SUPPLY,
Div. of Field Services, Epidemiology Program Office, Centers for Disease Control, Atlanta, GA 30333.
For primary bibliographic entry see Field 5C.
W88-07069

LEGIONNAIRES' DISEASE ACQUIRED WITHIN THE HOMES OF TWO PATIENTS, LINK TO THE HOME WATER SUPPLY,
Infectious Disease and Special Pathogens Section, Veterans Administration Medical Center.
For primary bibliographic entry see Field 5C.
W88-07070

MICROBIAL REMOVAL AND INACTIVATION FROM WATER BY FILTERS CONTAINING MAGNESIUM PEROXIDE,
C. P. Gerba, K. Hou, and M. D. Sobsey.
Journal of Environmental Science and Health JESEDU, Vol. 23, No. 1, p 41-58, January 1988. 6 tab, 15 ref.

Descriptors: *Disinfection, *Water treatment, *Microorganisms, *Magnesium peroxide, *Coliforms, *Filtration, *Drinking water, Performance evaluation, Water quality, Bacteria, Viruses.

Microporous filters containing MgO2 were effective in the removal and inactivation of bacteria and viruses from tqpwater. Pseudomonas aeruginosa, P. cepacia and Escherichia coli collected by the filters decreased in numbers to undetectable levels within 24 hours. In contrast, the same bacteria collected ond identical filters not containing MgO2, either rapidly increased in numbers or their numbers remained unchanged. Poliovirus type 1, Echovirus type 1, Reovirus type 3 and Rotavirus SA-11 were found to readily adsorb to the filters. The numbers or viruses which could be recovered from the MgO2 containing filters decreased rapidly with time as compared to control filters. No significant inactivation or bacteria or viruses occurred in tapwater passed through the filters, strongly suggesting that the microorganisms were being inactivated while adsorbed to the filters and not by substances released by the filters into the water. The filters remained effective even after the passage or large volumes of tapwater through small diameter filters and in the presence of raw sewage-contaminated tapwater. Such filters could potentially be useful for disinfection of water supplies for small community and individual water systems. (Author's abstract)
W88-07072

COAGULATION AND ADSORPTION OF HUMIC SUBSTANCES: AN ANALYSIS OF SURROGATE PARAMETERS FOR PREDICTING EFFECTS OF TRIHALOMETHANE FORMATION POTENTIAL,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. A. Chadik, and G. L. Amy.
Environmental Technology Letters ETLEDB, Vol. 8, No. 6, p 261-268, June 1987. 1 fig, 4 tab, 12 ref.

Descriptors: *Humic acids, *Water treatment, Coagulation, *Adsorption, *Raw water, *Trihalomethanes, *Trihalomethane formation potential, *Activated carbon adsorption, *Alum coagulation, *Organic carbon, *UV absorbance, United States, Chlorination, Drinking water.

Alum coagulation and activated carbon adsorption are effective water treatment processes for removing trihalomethane precursors from chlorinated drinking water. This study evaluated eight water sources and two synthetic water labs in the United States and describes the correlation between trihalomethane formation potential (THMFP) and surrogate parameters in untreated waters, treated waters derived from coagulation and treated waters derived from adsorption. Nonpurgeable organic carbon, UV absorbance, and fluorescence can serve as surrogate parameters for THMFP from the untreated state through various degrees of treatment with these processes. Multiplicative parameters such as the product of UV absorbance and NPOC can also function as effective surrogates. (Author's abstract)
W88-07133

OCCURRENCE AND CHEMISTRY OF HIGH FLUORIDE GROUNDWATERS IN JALORE DISTRICT OF WESTERN RAJASTHAN.
Ground Water Department, Jodhpur 342003, India.
For primary bibliographic entry see Field 5B.
W88-07187

BLADDER CANCER, DRINKING WATER SOURCE, AND TAP WATER CONSUMPTION: A CASE-CONTROL STUDY,
National Cancer Inst., Bethesda, MD. Div. of Cancer Etiology.
For primary bibliographic entry see Field 5C.
W88-07215

TREATMENT ALTERNATIVES FOR NITRATE CONTAMINATED GROUNDWATER SUPPLIES,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. F. Dahab.
Journal of Environmental Systems, Vol. 17, No. 1, p 65-75, 1987. 1 fig, 16 ref.

Descriptors: *Water treatment, *Nitrates, *Groundwater pollution, Nitrogen removal, Anion exchange, Biotransformation, Denitrification, Membrane processes, Reverse osmosis, Electrodialysis, Chemical precipitation, Feasibility studies, Economic feasibility, United States.

Nitrate concentrations in groundwater supplies throughout many areas in the United States, particularly in the Midwest, have steadily increased well past the maximum contaminant limit established by the Safe Drinking Water Act of 1974 and its amendments of 1986. There are several methods of removing nitrates from groundwater supplies with varying degrees of efficiency, cost, and relative ease. These methods include anion exchange, biological denitrification, reverse osmosis, electrodialysis, and, potentially, chemical precipitation. The technical feasibility and economics of these processes indicate that only the first three can be considered viable at the present. This article discusses the relative technical feasibility of removing nitrates from groundwater supplies when using the above mentioned methods. Results from bench-scale experiments as well as data from the literature are used to develop a basis of comparison. The results of this effort indicate that ion-exchange is most advantageous when dealing with moderate nitrate contamination situations. However, in extreme contamination cases, biological denitrification followed by other water-purification processes seems to be the most effective method of treatment. (Author's abstract)
W88-07225

COMPOSITION AND STRUCTURE OF REVERSE OSMOSIS FOULANT DEPOSITS FORMED FROM RAND WATER BOARD WATER: A PRELIMINARY INVESTIGATION,
National Inst. for Water Research, Pretoria (South Africa).
J. P. Leger, and L. C. Hawker.
Desalination DSLNAH, Vol. 61, No. 2, p 137-158, September 1987. 12 fig, 6 tab, 14 ref.

Descriptors: *Water treatment, *Membrane processes, *Chemical analysis, *Reverse osmosis, *Fouling, Mineral water, Chemical properties, Mineralogy, Physical properties, X-ray fluorescence, X-ray diffraction, Infrared spectroscopy, Electron microscopy, Organic compounds, Clays, Quartz, Iron compounds, Flushing, Cleaning, South Africa.

A statutory body, the Rand Water Board (RWB), is responsible for supplying most of the water consumed in the most important industrial and residential area of South Africa. The mineral quality of RWB water is steadily deteriorating due to increases in mining and industrial activity and domestic use. In a survey of the operating experiences of reverse osmosis plants processing RWB water, average membrane life was much less than that anticipated form experience in overseas plants. As the short membrane lifespan was caused by a number of factors including fouling, the elemental composition, mineral composition and physical structure of reverse osmosis foulant deposits formed from RWB water were investigated. The chemical and mineralogical properties and physical structure of the foulant deposits were studied by means of total elemental analysis, X-ray fluorescence and diffraction, selective dissolution analysis, infrared spectroscopy, and scanning and transmission electron microscopy. Most deposits comprised complex mixtures which included organics, colloi-

dal clays, quartz, and iron and zinc compounds. The finely divided clays were layered, oriented semi-parallel to the membrane surface and interwoven with organic matter. They were easily scraped off the membrane and were substantially soluble in strong alkali. It is suggested that RWB fouling may be ameliorated by turbulent flushing, flow reversal, sponge-ball cleaning, and alkali cleaning solutions. A simplified procedure for analyzing foulant deposits is also proposed. (Author's abstract)
W88-07228

PRE- AND POST-TREATMENT AT THE RO PLANT AT RA'S ABU JARJUR, BAHRAIN,
Ministry of Works and Power, Electricity Directorate, State of Bahrain.
For primary bibliographic entry see Field 3A.
W88-07233

PRETREATMENT OF SURFACE SEAWATER FEED AT DROP,
Petroleum, Petrochemicals, and Materials Division, Kuwait Institute for Scientific Research, P. O. Box 24885, 13109 Safat, Kuwait.
For primary bibliographic entry see Field 3A.
W88-07234

EVALUATION OF THE THREE POST-TREATMENT SYSTEMS AT DOHA SEAWATER REVERSE OSMOSIS PLANT--KUWAIT,
Water Resources Development Centre, Ministry of Electricity and Water, P. O. Box 12020, 71651 Safat, Kuwait.
For primary bibliographic entry see Field 3A.
W88-07235

OPERATION AND MAINTENANCE OF REVERSE OSMOSIS WATER DESALINATION PLANT OF THE KUWAIT OIL COMPANY,
Kuwait Oil Company, Kuwait.
For primary bibliographic entry see Field 3A.
W88-07240

OPTIMIZING THE REMOVAL OF GEOSMIN AND 2-METHYLISOBORNEOL BY POWDERED ACTIVATED CARBON,
Engineering Science Inc., Pasadena, CA 91103.
S. Lalezary-Craig, M. Pirbazari, M. S. Dale, T. S. Tanaka, and M. J. McGuire.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 73-80, March 1988. 18 fig, 15 ref.

Descriptors: *Water treatment, *Activated carbon, *Odor control, *Taste, Geosmin, Methylisoborneol, Humic acid, Chlorine, Organoleptic properties.

The conditions were examined under which removal of the taste- and odor-causing compounds geosmin and 2-methylisoborneol (MIB) by powdered activated carbon (PAC) was most efficient. A PAC dosage as low as 5 mg/L could reduce commonly occurring concentrations of these organics (up to 20 ng/L) to acceptable levels. Chlorine and monochloramine residuals appeared to have an adverse effect on the adsorption of geosmin and MIB by PAC, as did the presence of background humic acid. Filtration rate and contact time did not significantly affect removal efficiency. (Author's abstract)
W88-07383

USING COMPUTERS FOR WATER DISTRIBUTION MANAGEMENT,
Boston Water and Sewer Commission, Boston, Massachusetts.
L. Blank, and C. R. Johnson.
Public Works PUWOAH, Vol. 119, No. 2, p 46-48, 101-102, February 1988. 3 fig, 2 tab.

Descriptors: *Water supply systems, *Computer programs, *Water treatment facilities, *Maintenance, Boston.

The Boston Water and Sewer Commission (BWSC) recently implemented computerized procedures for maintaining its water distribution system. The computerized system tracks facility maintenance from beginning with a work order when a maintenance request is made, monitoring the job to completion, and ending with the retrieval of information on the facility's maintenance history. From the start of design to going on-line, the new work order system took approximately two years to implement. In the first nine months of the system's operation, from January 20 to October 31, 1987, 8,559 requests were logged, resulting in 8,667 work orders. As of November 1, 1987, there were 1,053 jobs in progress or awaiting posting. Twelve BWSC employees are skilled in operating the system on a daily basis, and new users are trained by 'old' users in the Water Division. The work order system is operating successfully, and the BWSC has just begun to explore the system's potential. Over time, the system will help the BWSC accomplish the following: determine the kinds of skills, equipment, and materials needed for maintenance; organize the maintenance yards and deploy crews; track main breaks and leaks; initiate scheduled maintenance of valves and hydrants; and schedule future capital investments. (Alexander-PTT)
W88-07481

RECOMMENDED PRACTICE FOR HYDROELECTRIC PLANT FIRE PROTECTION,
L. R. Hathaway.
Power Engineering POENDL, Vol. 92, No. 2, p 48-49, February 1988.

Descriptors: *Hydroelectric power, *Fine protection, *Planning, Power plants, Safety.

The National Fire Protection Association (NFPA) adopted a new document titled 'Recommended Practice for Fire Protection for Hydroelectric Generating Plants' (NFPA 851) in May 1987. The benefits of a document on fire protection for power plants include: (a) a 'road map' kind of resource that references other documents and provides appropriate tailored guidance where none currently exists; (b) encouragement for management to develop procedures and install fire protection systems and equipment to minimize the fire and explosion threat; and (c) it is a tool to more effectively spend every fire protection dollar. Further, this document was developed and is maintained by a balanced committee of experts not swayed by documents used by regulators or special interest groups. NFPA regulations stipulate compulsory review and reaffirmation every five years to ensure that they reflect current thinking. NFPA 851 provides recommendations (not requirements) for fire prevention and fire protection. It is intended to provide guidance to those charged with the design, procurement, construction and protection of hydroelectric power plants. The subcommittee's intent is that NFPA 851 only be applied to new hydroelectric projects, because blanket application to operating facilities may not be practical. (Alexander-PTT)
W88-07487

USE OF R2A MEDIUM AND THE SPREAD PLATE METHOD FOR THE ENUMERATION OF HETEROTROPHIC BACTERIA IN DRINKING WATER,
Anglian Water Laboratory, Grafham Water Treatment Works, West Perry, Huntingdon PE18 0BW, UK.
For primary bibliographic entry see Field 5A.
W88-07488

STUDIES ON REMOVAL OF MALATHION FROM WATER BY MEANS OF ACTIVATED CHARCOAL,
Aligarh Muslim Univ. (India). Chemistry Section.
S. R. Sharma, H. S. Rathore, and S. R. Ahmed.
Ecotoxicology and Environmental Safety EESADV, Vol. 14, No. 1, p 22-29, August 1987. 6 tab, 18 ref.

Descriptors: *Activated carbon, *Saline water, *Malathion, *Water treatment, *Pesticides, Elution, Adsorption, Chemical treatment, Agriculture, Drinking water.

The utility of activated charcoal for the removal of malathion from saline waters has been explored. The adsorption capacity of charcoal for malathion was 117 mg/g. Adsorption follows the Freundlich adsorption isotherms, the value of k and 1/n for charcoal being 1.6 and 0.60, respectively. Malathion can be eluted with methanol or ethanolic potassium hydroxide. (Author's abstract)
W88-07497

ELECTRODEIONIZATION FOR HIGH PURITY WATER PRODUCTION,
Millipore Corp., Bedford, MA.
G. C. Ganzi.
AICHE Symposium Series, Vol. 84, No. 261, p 73-83, 1988. 14 fig, 1 tab, 22 ref.

Descriptors: *Ion exchange, *Electrochemistry, *Resins, *High purity water, *Water treatment, Potable water, Hydrogen.

Electrodeionization is an ion-separation process using ion exchange resins and membranes. Unlike standard batch ion exchange, the resins are continuously regenerated during use without chemicals by imposition of a CD electric field. Although electrodeionization technology has been known for over thirty years, the first commercial equipment for water purification has recently been introduced by Millipore. This equipment is capable of producing high purity water (10 to 0.1 microsiemens/cm conductivity or less) from potable water sources at high electrical efficiency. Data on performance are reviewed and operating regimes modeled by relating mass transfer to electron transfer, and to electrochemical production of hydrogen and hydroxide ions. Systems design specifications are also presented. (Author's abstract)
W88-07503

ADSORPTION OF POLLUTANTS FROM WASTEWATER ONTO ACTIVATED CARBON BASED ON EXTERNAL MASS TRANSFER AND PORE DIFFUSION,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W88-07538

FORMATION OF TRICHLORONITROMETHANE (CHLOROPICRIN) AND CHLOROFORM IN A COMBINED OZONATION/CHLORINATION TREATMENT OF DRINKING WATER,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, and H. Bader.
Water Research WATRAG, Vol. 22, No. 3, p 313-319, March 1988. 2 fig, 8 tab, 16 ref.

Descriptors: *Water treatment, *Water pollution sources, *Ozonation, *Chlorination, *Disinfection, *Chlorinated hydrocarbons, Chloroform, Chloropicrin, Trichloronitromethane, Trihalomethanes, Nitrilotriacetic acid, Lake Zurich, Switzerland, Lakes, Oxidation, Activated carbon, Organic matter.

Chlorination of water from mesotrophic Lake Zurich and eutrophic Greifensee produced about 0.4 and 2 microgram/liter of trichloronitromethane (TCNM), respectively. Preozonation increased these values to about 2 and 6 microgram/liter, respectively. Chloroform formation was reduced by preozonation, from 24 to 15 and from 50 to 30 microgram/liter, respectively. In all experiments, TCNM formation was <20% of chloroform formation. Activated carbon treatment eliminated most of the TCNM but not the chloroform. The addition of 0.1 mg/liter of nitrilotriacetic acid (NTA) to the lake water had a barely detectable effect on TCNM formation. Iminodiacetic acid, a possible byproduct of ozonolysis of NTA, had a larger effect on the formation of TCNM than NTA itself. However, it was not expected to accumulate as a precursor substance under normal treatment conditions of non-enhanced ozone decomposition. Triethanolamine produced 50 times the TCNM than did NTA. (Cassar-PTT)

W88-07542

SOME INTERMEDIATES IN THE WET AIR OXIDATION OF PHENANTHRENE ADSORBED ON POWDERED ACTIVATED CARBON,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
R. A. Larson, H. L. Ju, V. L. Snoeyink, M. A. Recktenwalt, and P. A. Dowd.
Water Research WATRAG, Vol. 22, No. 3, p 337-342, March 1988. 2 fig, 2 tab, 13 ref. EPA Cooperative Agreement No. CR806819.

Descriptors: *Waste treatment, *Water treatment, *Activated carbon, *Sludge disposal, *Oxidation, *Aromatic compounds, *Phenanthrene, Wet air oxidation, Toxicity, Chemical degradation, Degradation.

Phenanthrene, a tricyclic aromatic hydrocarbon, was rapidly destroyed when sorbed onto Nuchar SA powdered activated carbon and subjected to conditions typical of wet air regeneration. Hydrodarco H carbon was less efficient. The 15 intermediate degradation products included phenol, benzoic acid, o-hydroxybenzaldehyde, salicylic acid, phthalic acid, phthalide, 2-hydroxy-2'-carboxybiphenyl, 2-(2-formylphenyl) benzoic acid, 2,2'-diphenic acid, 1,2-naphthoic anhydride, 3,4-benzocoumarin, fluorenone, anthroquinone, phenanthrenequinone, and dialdehyde. Degradation appeared to involve very reactive and unselective oxidants, such as the hydroxyl radical, on the activated carbon surface. Toxicity of the degradation mixture to yeast was noticeable in the early stages of wet air regeneration, but decreased in later stages. Similar extracts of phenanthrene-loaded and wet air regenerated carbon were not mutagenic in the Ames test. It was concluded that the wet air regeneration method effectively destroyed phenanthrene (and by inference, other adsorbed aromatic compounds). However, possible generation of harmful intermediate products must be considered. (Cassar-PTT)
W88-07545

EFFECTS OF BROMIDE CONCENTRATION ON THE PRODUCTION OF CHLOROPICRIN DURING CHLORINATION OF SURFACE WATERS. FORMATION OF BROMINATED TRIHALONITROMETHANES (INFLUENCE DE LA CONCENTRATION EN BROMURES SUR LA FORMATION DE CHLOROPICRINE LORS DE LA CHLORATION DES EAUX. MISE EN EVIDENCE DE TRIHALONITROMETHANES BROMES),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
H. Thibaud, J. de Laat, and M. Dore.
Water Research WATRAG, Vol. 22, No. 3, p 381-390, March 1988. 11 fig, 4 tab, 18 ref.

Descriptors: *Water treatment, *Bromides, *Trihalonitromethane, *Chlorination, *Disinfection, Chloropicrin, Organic compounds, Oxidation, Humic acids, Phenols, Nitrophenols, Organic matter.

The following were chlorinated in the presence of varied amounts of bromide: solutions of standard compounds (nitromethane, nitrophenols), solutions of isolated aquatic humic substances (fulvic acids), raw surface waters, and dissolved organic matter from surface waters. Increasing bromide concentrations led to a decrease in the production of chloropicrin (trichloronitromethane) and an increase in the production of other chlorinated compounds (dichlorobromonitromethane, dibromochloronitromethane, and tribromonitromethane). The amount of tribromonitromethane formed was greater at higher bromide concentrations. During chlorination of raw surface waters and fulvic acids, from 0.1 to 1.5 microgram of chloropicrin/mg dissolved organic carbon was formed. More than 90% of the chloropicrin formed during surface water chlorination was produced from the organic precursors in the >500 AMW range. However, under the analytical conditions of the study, the brominated trihalonitromethanes were not detected in chlorinated surface waters and in chlorinated solutions of fulvic acids. (Cassar-PTT)

W88-07551

SYNTHESES AND APPLICATION OF ANIONIC POLYELECTROLYTES IN WATER AND WASTEWATER TREATMENT,
Central Power Research Inst., Bangalore (India).
G. U. Bhaskar, and S. K. Gupta.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 251-260, October 1987. 6 fig, 2 tab, 11 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Anionic polyelectrolytes, *Flocculation, *Polymers, Monomers, Organic compounds, Hydrogen ion concentration, Chemical oxygen demand, Coliforms, Performance evaluation, Bacteria.

Five anionic polyelectrolytes were prepared with different molar ratios of acrylamide and acrylic acid monomers and investigated for application in water and wastewater treatment as coagulant aids. The optimum flocculation conditions were found to depend on the polyelectrolyte and characteristics of the sample. The optimum time for flash mixing for alum and for polyelectrolytes was 1 to 2 min. The optimum flocculation time was 10 to 25 min and optimum flocculation intensity varied between 20 to 30 rpm. The pH was found to be inversely proportional to flocculation efficiency. The COD removal and coliform bacteria removal were 65 and 98%, respectively. (Author's abstract)
W88-07602

INVESTIGATION OF THE PRODUCTION OF LIPOPHILIC VOLATILE ORGANOHALOGENS DURING THE LABORATORY CHLORINATION OF NONPOLLUTED SURFACE WATER SAMPLES IN YUGOSLAVIA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
M. Picer, V. Hocenski, and N. Picer.
Water, Air, and Soil Pollution WAPLAC, Vol. 35, No. 3/4, p 411-421, October 1987. 4 fig, 3 tab, 21 ref.

Descriptors: *Chlorination, *Water treatment, *Surface water, *Halogenated hydrocarbons, *Organohalogens, *Water analysis, Pollutant identification, Trihalomethanes, Chlorinated hydrocarbons, Organic carbon, Organic matter, Humic acids.

Water chlorination leads to the generation of various halogenated products of natural and waste water organic matter. In natural surface water humic matter usually constitutes the greatest part of the total organic matter. However, in river water polluted with various organic wastes, other organic matter is also present in significant concentrations. The relationship between the concentrations of organic matter in relatively nonpolluted lake and river waters in Yugoslavia and the production of the lipophilic volatile organohalogen materials during the process of their chlorination is described. The production of the halomethanes and other ECD response materials during the chlorination of water samples in laboratory conditions was compared with the concentrations of organic materials in water samples. From the linear correlation coefficients obtained, the possibility of predicting amounts of organohalides generated during the chlorination process by using several very simple methods for the estimation of organic materials estimation in the investigated water samples is discussed. (Author's abstract)
W88-07606

WATER METER TESTING TO RAISE REVENUES: AN ABSOLUTE NECESSITY IN A DIFFICULT ECONOMY,
The Ford Meter Box Company, Wabash, Indiana.
For primary bibliographic entry see Field 7B.
W88-07651

CUSTOMER SERVICE SURVEY,
Little Rock Municipal Water Works, AR.
For primary bibliographic entry see Field 6B.
W88-07653

EFFECT OF COMPLEXATION ON THE ADSORPTION OF CADMIUM BY ACTIVATED CARBON,
For primary bibliographic entry see Field 5D.
W88-07655

EVALUATION OF GAS SUPERSATURATION TREATMENT EQUIPMENT AT FISH HATCHERIES IN MICHIGAN AND WISCONSIN,
U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, LaCrosse, WI 54602, USA.
L. L. Marking.
Progressive Fish-Culturist PFCUAY, Vol. 49, No. 3, p 208-212, July, 1987. 2 fig, 1 tab, 6 ref.

Descriptors: *Fish hatcheries, *Michigan, *Wisconsin, *Supersaturation, *Oxygenation, Toxicity, Mortality, Fish, Trout, Performance evaluation, Fish diseases, Animal diseases, Aeration, Oxygen, Dissolved oxygen, Cost analysis, Nitrogen, Technology.

Fish hatcheries operated in Michigan and Wisconsin have reported severe mortalities of lake trout (Salvelinus namaycush) in recent years, largely from gas bubble disease. Until 1985, the systems most commonly used to alleviate this condition were packed column aeration units and vacuum degassers. Sensitive species require water that is both free of gas supersaturation and has high dissolved oxygen. Packed column aeration decreases supersaturation to about 104% and simultaneously increases dissolved oxygen in the treated water. Vacuum degassers can decrease supersaturation to less than 100%, but the negative pressure applied in this process also reduces the dissolved oxygen. Oxygen injection systems effectively decrease nitrogen and total gas pressure to less than 100% and increase oxygen to saturation or even higher desired concentrations. Oxygen generators are cost-effective because operating expenses are largely or completely offset by the improved production and vigor of the fish produced. Although not all the details of oxygen generation systems have been published, the technology is at hand and commercial units are available. It is concluded that oxygen injection systems should be considered if gas supersaturation is a problem or if increased production is a goal. (Author's abstract)
W88-07663

EFFICACY OF ULTRAVIOLET WATER TREATMENT AT THE GREEN LAKE, MAINE, NATIONAL FISH HATCHERY,
Leadville National Fish Hatchery, 2842 County Road 300, Leadville, CO 81638, USA.
V. K. Cross, and L. Peterson.
Progressive Fish-Culturist PFCUAY, Vol. 49, No. 3, p 233-235, July, 1987. 10 ref.

Descriptors: *Ultraviolet radiation, *Fish hatcheries, *Green Lake, Maine, *Disinfection, *Water treatment, *Design criteria, *Performance evaluation, Radiation, Filtration, Fish diseases, Animal diseases, Bacteria, Pathogenic bacteria, Bacterial analysis, Water treatment facilities, Pipelines, Aeromonas.

The water treatment system of the Green Lake National Fish Hatchery in Ellsworth, Maine was evaluated for its efficacy in reducing bacteria during the period September, 1980 to September, 1981. The system consists of 20- micron filtration followed by ultraviolet irradiation averaging 28,400 microW/s/sq cm. Weekly 500-ml grab samples of water were taken for quantification of bacteria before and after treatment. Bacterial counts in untreated supply water averaged 6,165/100 ml, while counts in treated water averaged 44.8/100 ml, a 99.3% reduction. It is suggested that, in designing future facilities, the disinfection units should be as close to the rearing facility as possible to eliminate the possibility of recontamination. Water supply pipelines should be designed to keep dead areas to a minimum, and a method should be provided to disinfect all pipelines. (Doria-PTT)
W88-07664

BACTERIOLOGICAL QUALITY OF TRADITIONAL WATER SOURCES IN NORTH-EASTERN IMO STATE, NIGERIA,
London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
For primary bibliographic entry see Field 5A.
W88-07667

RETROFITS/MANAGEMENT MEET TOUGH WATER QUALITY CONSTRAINTS,
R. C. Rittenhouse.
Power Engineering POENDL, Vol. 91, No. 11, p 24-26, November, 1987. 3 ref.

Descriptors: *Industrial water, *Wastewater treatment, *Water treatment, *Boiler water, *Data processing, *Computer programs, Water management, Water quality, Automation, Powerplants, Legal aspects, Permits, Regulations, Runoff, Flocculation, Sludge thickening, Sludge drying.

Because water management has an important influence on power plant operating reliability and efficiency, there has been a growing trend toward upgrading water handling and treatment systems. Some facets of the overall scheme of improvements are reviewed. The latest computer programs may contribute the most to the upgrading and fine-tuning of operating systems. The program known as WATERMAN, containing technical and economic data bases, is discussed. The program, a template that fits over Framework II, allows the user to prepare a water balance for a plant without having to understand Framework II or a spreadsheet. Other topics covered include different power plant concerns in different regions of the country, the problem of flooded underground coal yard reclaim hoppers, and steps taken to control coal pile runoff at Griffiss Air Force Base's central heating plant. It is concluded that, whether answers are found via computer application or by routine mechanical means, water system upgrades can contribute substantially to a longer, more productive life for large and small power plants. (Doria-PTT)
W88-07676

SUSPENDED SOLIDS CARRY-OVER CONTROL IN BOTTOM ASH DEWATERING BINS,
Public Service Co. of New Mexico, Albuquerque.
M. DeField, and B. Thompson.
Power Engineering POENDL, Vol. 91, No. 11, p 36-39, November, 1987. 2 fig, 5 tab.

Descriptors: *Flocculation, *Water treatment, *Suspended solids, *Wastewater treatment, *Water reuse, *Industrial water, *Dewatering, *Powerplants, *Cost analysis, Settling tanks, Sedimentation, Scaling, Calcium carbonate, Sludge, Economic aspects, Costs.

A flocculant program is discussed that cut costs and eliminated solids from power plant recirculating water after system modifications for zero discharge. As part of the redesign process for the San Juan Generating Station, bottom ash system blowdown was eliminated, increasing total dissolved and suspended solids levels in the recirculating ash water loops. Also, effluent from ash loadout areas with cleanup sumps, previously routed to wastewater treatment ponds, was being returned to the bottom ash handling system. Polymer feed systems were installed to deal with the resulting problems. Topics discussed include ash settling, problem definition, suspended solids control, scale control, and program economics. Cost savings are due mainly to the dewatering bin cleanings, ash loading area cleanup sump return credit, and high-pressure ash pump repairs. The annual savings at the station at all four units resulting from implementation of the bottom ash treatment programs exceeds $1.4 million. The savings gained in reducing suspended solids carry-over has more than justified the costs, enhancing power plant operations as well as the zero discharge plan. (Doria-PTT)
W88-07677

PORTABLE WATER PRETREATMENT CUTS DEMINERALIZER LOADING,
Public Service Co. of Indiana, Inc., Plainfield.
S. Glover.
Power Engineering POENDL, Vol. 92, No. 1, p 31-33, January, 1988. 1 fig, 3 tab.

Descriptors: *Water treatment, *Demineralization, *Well water, *Dialysis, *Pretreatment of water, *Powerplants, Performance evaluation, Membrane processes, Water analysis, Costs, Acidity, Technology.

System characteristics and performance data are reported evaluated for two portable, 200-gpm electrodialysis reversal (EDR) systems that provide pretreatment of water drawn from deep wells for Public Service Indiana's Gibson station. Each system is housed in a trailer and contains the standard components of the Ionics Aquamite XX system, including a feed tank, two multimedia sand filters, and a product surge tank. System operation is described. Performance data are presented, showing a comparison between typical well-water feed, EDR product water, and the EDR concentrated brine stream, with percentage reductions for each of the species listed. The reduction in loading on plant demineralizers has increased demineralizer throughout by about 400%, and permits maintenance that was impossible or extremely expensive. Use of the system costs little more than what was previously spent to produce demineralized water. The system does not appear to be adversely affected by high-barium waters and can take an occasional manganese excursion without irreparable damage. It is concluded that the use of the portable EDR system appears to be an economical short-term solution to the strain imposed on demineralizer capacity by deteriorating well-water quality. (Doria-PTT)
W88-07678

WATER DISTRIBUTION SYSTEM INFRASTRUCTURE STUDY, CITY OF NORWICH, N.Y.,
Susquehanna River Basin Commission, Harrisburg, PA.
D. R. Jackson, and E. E. Seay.
Publication No. 79. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. July 1983. 101 p, 17 tab, 1 plate.

Descriptors: *Water supply, *Water distribution, *Norwich, *New York, *Pipelines, *Hydraulic models, *Water conveyance, *Pumps, Hydraulic structures, Economic aspects, Leakage, Water use, Water loss.

A study has been made to assess the physical and operational capabilities of the water distribution system of the City of Norwich, NY. Needs for repair and rehabilitation of the system were considered. The study includes development of a hydraulic model for analysis of the distribution system, and interpretation of computations made with the model to locate areas where possible problems exist. A general financial analysis was made to determine whether the utility is currently in a position to fund needed improvements. Also, the water use rate structure was evaluated. The following problems have been identified: (1) The Tillman Ave. and Rexford St. pumps do not provide as much head increase as they should; (2) The pipes in most of the distribution system have very low capacity, in many cases as little as 25% of the capacity they should have; (3) There are a number of dead end mains in the system; (4) The system may not be capable of providing needed fire flows as computed by the Insurance Services Office; (5) The amount of unaccounted-for water is in excess of 50% which is extremely high; (6) There may be a problem of excessive pressures in Pressure District No. 3 at the east end of the Sunset Drive; and (7) There is a need to keep main break records. Some of the recommendations made were: (1) The Board should work with pump manufacturers to determine whether there is a simple and easily remedied reason why the Rexford St. and Tillman Ave. pumps do not provide as much head increase as they should; (2) The Board should continue and expand the leak detection, and meter replacement programs. All uses should be metered and detector check valves should be installed on dedicated fire service lines; (3) Eight sections of existing pipe should be investigated in detail to determine whether discrepancies between observed and computed pressures are due to leakage, unauthorized use, or severe loss of capacity; (4) More intensive use of data processing services may aid in solving certain problems, particularly unaccounted for water; (5) The rate structure should be evaluated and a cost of service study made; and (6) Main break records should be kept and analyzed. (Lantz-PTT)
W88-07729

COMPARISON OF DISSOLVED AND LEACHABLE TRACE METALS IN LOS ALAMOS DRINKING WATER SUPPLY AND DISTRIBUTION SYSTEM SPECIMENS,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5A.
W88-07747

COMPARISON OF HIGH MOLECULAR WEIGHT ORGANIC COMPOUNDS ISOLATED FROM DRINKING WATER IN FIVE CITIES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-07792

USE OF GEL PERMEATION CHROMATOGRAPHY TO STUDY WATER TREATMENT PROCESSES,
Lyonnaise des Eaux Central Lab., 38 rue du President Wilson 78230, Le Pecq, France.
A. Bruchet, Y. Tsutsumi, J. P. Duguet, and J. Mallevialle.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 381-399, 13 fig, 1 tab, 29 ref.

Descriptors: *Water treatment, *Water quality control, *Chromatography, *Gel permeation chromatography, *Water analysis, Vigneux, France, Volatile compounds, Organic compounds, Case studies, Monitoring, Humic matter, Organic carbon.

The efficiency of a water treatment process is often evaluated by using nonspecific and specific parameters. Most of the time, specific determinations involve extraction techniques followed by gas chromatography (GC) or high-performance liquid chromatography. Consequently, determinations are limited to the study of volatile and semivolatile organics. Presented here is a gel permeation technique used to study higher molecular weight or more polar compounds. The gel permeation chromatography (GPC) and pyrolysis GC-mass spectrometry were used in a pilot study at Vigneux, south of Paris, to determine the efficiency of the combination of ozone and granular activated carbon unit processes. The use of GPC in combination with pyrolysis GC-MS has proven to be a very powerful tool to evaluate the efficiency of water treatment processes. The measurement of nonspecific parameters after separation by Sephadex GPC allows mass balances to be determined and allows insight into the structures of the background organic matrix as well as the effects of water treatment unit processes on the matrix. Beyond demonstrating the potential of the technique, several specific conclusions can be drawn with respect to the Vigneux pilot plant: (1) Only 15% of the total organic carbon (TOC) in sand-filtered water is due to compounds having MWs > 5000; (2) Humic material does not appear to be a prominent component of this HMW fraction. The principal components appear to be proteins and sugars, particularly N-acetylamino sugars, which probably originate from the degradation of microbial cell walls; (3) These proteins and amino sugars are practically unaffected by the ozonation process; (4) Humic substances dominate the intermediate MW (1000-5000) range, which represents 29% of the TOC and thus contributes substantially to the carbon balance; and (5) Polymerization may occur during ozonation, as suggested by the increase in the TOC of the intermediate MW frac-

tion and the increase in the phenolic compounds found in this fraction. (See also W88-07783) (Lantz-PTT)
W88-07801

CONCENTRATION, FRACTIONATION, AND CHARACTERIZATION OF ORGANIC MUTAGENS IN DRINKING WATER,
National Inst. of Public Health and Environmental Hygiene, Leidschendam, The Netherlands.
For primary bibliographic entry see Field 5A.
W88-07812

MUTAGENIC ACTIVITY OF VARIOUS DRINKING WATER TREATMENT LINES,
Lyonnaise des Eaux Central Lab., 38 rue du President Wilson 78239, Le Pecq, France.
L. Cognet, J. P. Duguet, Y. Courtois, J. P. Bordet, and J. Mallevialle.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 627-640, 4 fig, 7 tab, 20 ref.

Descriptors: *Toxicity, *Water pollution effects, *Drinking water, *Water treatment, *Water analysis, *Ozonation, *Mutagens, *Chlorination, Adsorption, Organic compounds, Ames test, Microbiological studies, Statistical studies, Filtration, Activated carbon.

Mutagenic activity in several treatment alternatives at a water treatment pilot plant was studied for one year. Water extracts were completed by the adsorption of organics on macroreticular resins. Mutagenicity was determined by the Ames Salmonella microsome test. Statistical analyses of the data (Wilcoxon signed ranks test and factor analysis of correspondence) were applied to understand the complexity and variations observed in the data. Results showed that: (1) ozone decreased or increased mutagenic activity depending on treatment conditions; (2) granular activated carbon (GAC) filtration was less efficient than ozone; and (3) GAC combination and disinfection with chloride dioxide was less mutagenic than chlorine treatment. (See also W88-07783) (Author's abstract)
W88-07813

USERS MANUAL FOR FLOOD EVACUATION PLANNING OF WATER AND WASTEWATER TREATMENT PLANTS,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5D.
W88-07849

INNOVATIVE APPROACHES TO TRANSPORTATION OF WATER BY TANKER,
International Association of Independent Tanker Owners (Intertanko), Oslo, Norway.
T. A. Meyer.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 119-135, 1 tab.

Descriptors: *Water transport, *Water supply development, *Ships, *Oil tankers, *Developing countries, Transportation, Economic aspects, Icebergs, Water resources development, Oily water, Water quality, Water demand, Cost analysis, Ballast, Icebergs.

The possibility of supplying freshwater by tankers to developing countries is explored. Since many oil tankers must take on ballast for their return journeys, freshwater may be substituted in place of seawater at no additional cost. Due to the economic losses suffered by many oil tanker fleets in recent years, the prospects for tanker availability in the future seem dim. The increased value of oil since 1973 and environmental restrictions on ballast water discharges, have led to improved tanker cleaning technologies and operations. Cargo tanks on the ballast legs should be much cleaner for the transportation of freshwater. The infrastructure for the loading, discharge and delivery of freshwater is discussed. Intertanko (the International Association of Independent Tanker Owners) has attempted to survey available and planned water port facilities around the world. The properties of oil/water mixtures are discussed in terms of the environmental effects of ballast discharge. Processes for the separation of oil/water mixtures, health considerations, and water quality monitoring of imported water are considered. The use of exported water for potable purposes, irrigation, industry, and contingency water is discussed. Tankered water supplies also provide for alternative sources of water for desalination. The economics of transporting water are considered. The possibility of transporting icebergs for freshwater use is discussed. (See also W88-07850) (Geiger-PTT)
W88-07858

MARITIME TRANSPORTATION OF FRESH WATER,
International Maritime Organization, London (England).
J. W. Hargreaves.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 136-147, 2 tab, 3 ref.

Descriptors: *Water transport, *Water supply development, *Ballast, *Oil tankers, *Developing countries, Water quality, Economic aspects, Marketing, Cost analysis, Transportation, Ships, Capital costs, Drinking water, Water use, Water resources development.

Water transportation is not a new concept; however, there remains a large potential which has yet to be utilized. One of the reasons for not taking up this option as a method of providing water is a general lack of understanding of the feasibility of the method. The argument that countries do not wish to be dependent on a foreign source is accepted, but in many ways water is similar to oil in terms of economic dependency. The level of dependency of a country on imported freshwater can be minimized by good strategic planning. In this context importation should be seen as an additional source which can be integrated into any overall resource planning strategy. Where a country's natural water resources are dwindling through overuse, and there are financial constraints which prevent massive expenditure on other methods of providing water, importation has many advantages. Apart from the financial advantage of not requiring large investment, importation is a relatively simple, low technology, low labor intensive option where the client controls the quality and quantity requirements and where the onus is on the exporter to meet those requirements. (See also W88-07850) (Author's abstract)
W88-07859

TRANSPORT OF DRINKING WATER IN SEGREGATED BALLAST TANKS,
Municipal Waterworks of Rotterdam (The Netherlands).
C. Wielenga.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 148-159, 1 fig, append.

Descriptors: *Water transport, *Oil tankers, *Drinking water, *The Netherlands, *Water treatment, Water supply development, Ballast, Water costs, Transportation, Cost analysis, Water quality, Economic aspects, Oily water, Pricing, Potable water, Desalination.

The port of Rotterdam has two types of water available for export by tankers - potable drinking water and lower quality freshwater. Water can be carried as ballast in segregated ballast tanks or in cargo tanks. An example of the costs of carrying drinking water in the segregated ballast tanks of crude oil tankers is given. The entire process from the purchase of the drinking water to the final consumer consists of the following steps: purchase of water, loading (shifting, storage, pumping, delay), transport, unloading (shifting, storage, pumping, delay), post-treatment, and distribution. The final costs of drinking water carried in cargo tanks are valued at U. S. $2.50 to $3.00/cu m. In comparison, the costs of drinking water carried by shuttle (tankers used for water transport only) and those of desalinated water are valued at $8.00 to $8.50/cu m and $4.50 to $8.00/cu m, respectively. (See also W88-07850) (Geiger-PTT)
W88-07860

OVERVIEW OF WATER REUSE FOR DEVELOPING COUNTRIES,
American Water Works Association Research Foundation, Denver, CO.
For primary bibliographic entry see Field 3C.
W88-07861

WASTE-WATER REUSE AND ITS APPLICATIONS IN WESTERN ASIA,
Economic and Social Commission for Western Asia (ESCWA), Baghdad (Iraq). Natural Resources, Science and Technology Div., Water Resources Section.
For primary bibliographic entry see Field 3C.
W88-07862

ANTIGUA (EXPERIENCES WITH TRANSPORTATION OF WATER BY TANKER),
Antigua Public Utilities Authority (APUA), St. John's (Antigua).
S. A. Blackman.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 441-444.

Descriptors: *Water transport, *Antigua, *Developing countries, *Water supply development, *Water storage, Storage tanks, Water quality, Ships, Water tanks, Water shortage.

The water resources of Antigua are limited by its small size, topography, geological formation, natural salinity of some of the geological strata, and the variability of the rainfall pattern across the island. After the drought of 1984, the government of Antigua sought international assistance to cope with the water shortage. Four donor agencies agreed to ship water on barges to the island. Facilities for receiving barged water included the Crabbs Peninsula, the High Point Dock, the Saint John's Deep Water Harbor and the main beach hotels. A storage tank at a former desalination plant was used to hold water at the Crabbs Peninsula site. Water at the High Point Dock was pumped into a small section of the total distribution system. At the Deep Water Harbor, water was pumped directly into the distribution system through existing four and six-inch pipelines. Several hotels made private arrangements for the barging of water to their facilities. The Antigua Public Utilities Authority (APUA) obtained the services of two private organizations to execute the required barging exercises. Before each shipment of water was received, APUA personnel tested it for color, pH, and chlorine residual. Communication between ship and shore was essential between the pumping and receiving stations. Clear channel and mooring markings were also very helpful during the barging exercises. Agreement on a standardized procedure for use in measuring the quantity of water delivered was absolutely necessary. AUPA experience with barging indicates that it is a viable alternative that rivals other non-conventional water resources options in cost and flexibility. (See also W88-07850) (Geiger-PTT)
W88-07887

DOMINICA: CARIBBEAN EXPERIENCES WITH TRANSPORTING WATER BY TANKER,
Central Water Authority, Dominica (W.I.).
S. C. De Haan.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 445-450, 1 fig.

Descriptors: *Water transport, *Tankers, *Dominica, *Water supply developmnet, *Drinking water, Water costs, Project planning, Developing countries, Potable water, Feasibility studies.

The island of Dominica in the Caribbean has become a source of water for export by tankers or barges since a facility for this purpose was recently constructed on the island. During the wet season the island receives rainfall almost every day. Even during the dry season it rains regularly, giving the island a surplus of freshwater. Several deep water areas exist around the island making it possible for vessels to berth near the shore. This decreased the cost of pumping water onto vessels as shorter pipelines are required. The drinking water supply of Roseau and surrounding areas provide most of the water for export. The system operates by gravity but several variables affect the cost of water transport by tankers. The most critical of these are: distance between loading port and discharge port; controlling water depth and mode of transport used; matching volumes and tankerage for full equipment utilization; and timing and duration of the project. The feasibility of using the Padu electric power station in the Roseau Valley for exporting water should be examined. (See also W88-07850) (Geiger-PTT)
W88-07888

MEDITERANEAN AREA: EXPERIENCES WITH SHIPPING FRESH WATER,
Societe du Canal de Provence (France).
F. Bonifacio.
IN: Non-Conventional Water Resources Use in Developing Countries. Proceedings of the Interregional Seminar, Willemstad, Curacao, Netherlands Antilles, April 22-28, 1985. p 451-454.

Descriptors: *Water transport, *France, *Mediterranean countries, *Drinking water, *Water supply development, Potable water, Evaluation, Feasibility studies, Water quality, Tankers, Oily water, Water costs, Water demand, Ballast.

The experience acquired by the Port of Marseilles Authority (PMA) and the Canal of Provence Authority (CPA) of France in shipping freshwater throughout the Mediterranean is discussed. Water exporting operations took place in 1983 when 1,300,000 cu m of freshwater were shipped by tanker out of Marseilles harbor to Tarragona in Spain for the EMPETROL Refinery. The PMA and the CPA could guarantee regular supplies of water from the French Alps. EMPETROL, for its part, supplied a shuttle vessel, a tanker of 92,790 dwt. The quality of the water did not vary during transport and when mixed with local water provided a better average mix. Such shipped supplies could become viable supplements to countries that have water shortages. Water transport can be used as an additional source of supply for countries that rely on desalination for freshwater. Imported water could be used during times of desalination plant shutdowns due to failure of equipment or routine maintenance. The PMA and the CPA are prepared to assist countries in finding solutions to their water supply problems. (See also W88-07850) (Geiger-PTT)
W88-07889

FACTORS PREDISPOSING TO LEGIONELLA PNEUMOPHILA COLONIZATION IN RESIDENTIAL WATER SYSTEMS,
Veterans Administration Medical Center, Pittsburgh, PA. Special Pathogens Section.
T. C. Lee, J. E. Stout, and V. L. Yu.
Archives of Environmental Health AEHLAV, Vol. 43, No. 1, p 59-62, January/February 1988. 1 tab, 10 ref.

Descriptors: *Microorganisms, *Microbiological studies, *Public health, *Bacterial analysis, *Impaired water quality, *Domestic water, *Potable water, *Water management, *Metropolitan water management, *Temperature effects, Legionella pneumophila colonization, Residential water systems, Pennsylvania, Urban areas, Suburban areas, Legionnaire's disease.

Fifty-five homes in the Pittsburgh area were surveyed for the presence of Legionella pneumophila colonization. Hot water tanks, faucets, and showerheads were sampled. Six homes yielded L. pneumophila within the water distribution system. Lower water temperatures (< 48.8 C) within the hot water system were significantly associated with the presence of L. pneumophila colonization. A similar association was found for electric heaters; however, this association may be an indirect one. Water temperatures in electrically heated tanks were significantly lower than in gas-heated tanks. City residents were also more likely to be colonized than suburban residences. Because acquisition of Legionnaire's disease in the community has been linked to colonization of the water supplies in the homes of affected patients, these findings may have clinical implications for susceptible individuals residing in homes with water supplies colonized by L. pneumophila. (Author's abstract)
W88-07941

5G. Water Quality Control

BACTERIOLOGICAL CONTAMINATION OF WATER IN RURAL AREAS: AN INTERVENTION STUDY FROM MALAWI.
Dept. of Pediatrics, Linkoping University Hospital, S-581 85 Linkoping, Sweden.
R. U. M. Lindskog, and P. A. Lindskog.
Journal of Tropical Medicine and Hygiene, Vol. 91, No. 1, p 1-7, February 1988. 2 fig, 5 tab, 19 ref.

Descriptors: *Bacteria, *Water supply, *Public health, *Water pollution treatment, *Drinking water, *Rural areas, *Malawi, *Water quality, *Coliforms, Streptococcus, Well water, Spring water, Riparian waters, Water conveyance, Rainfall intensity, Surface waters.

The bacteriological quality of drinking water sources and of stored household water was examined in a rural area of Malawi, before and after improvement of the method of water supply. Among the traditional water sources, water quality was better in springs than in wells and rivers. During the rainy season, there was a considerable deterioration of water quality, which was most pronounced in wells. The improved water supply system consisted of piped, untreated surface water from an uninhabited mountain area. This water contained a mean value of 54 fecal coliforms per 100 mL which can be regarded as acceptable in this setting. During collection of drinking water and during household storage, there was considerable contamination, which mirrored the unhygienic environment. Contamination was worse during the rainy season than during the dry season. Technical interventions aimed at improving water supply in rural areas of developing countries will probably not become effective unless combined with comprehensive health education programmes for the population concerned. (Author's abstract)
W88-06847

BIRCH LEAF PROCESSING AND ASSOCIATED MACROINVERTEBRATES IN AN ACIDIFIED LAKE SUBJECTED TO LIMING,
Bergen Univ. (Norway). Zoological Museum.
A. Fjellheim, and G. G. Raddum.
Hydrobiologia HYDRB8, Vol. 157, No. 1, p 89-94, January 8, 1988. 4 fig, 1 tab, 26 ref.

Descriptors: *Water quality control, *Lakes, *Acidic water, *Lime, *Invertebrates, *Leaves, Litter, Lake Store Hovvatnet, Lake Lille Hovvatnet, Norway, Detritus, Neutralization, Midges, Aquatic insects, Insects, Benthos, Organic matter, Grazing, Decomposition.

Bags of birch leaf litter were placed in an acid lake (Lille Hovvatnet, pH 4.3-4.7) and in an acid lake which was limed (Store Hovvatnet, pH variable according to site) and left for 2 years. No significant differences in decomposition rates between the various localities at the same depth were noticed. Weight loss was greatest during the first year, about 35-55%. Decomposition was more rapid at the 2-m depth (57-69% loss after 2 years) than at the 5-m depth (44-55% loss after 2 years). The initial energy content of the leaves was about 5 cal per mg dry weight. After two years of exposure this was reduced to about 4 cal per mg dry weight, with no significant differences between the limed and the untreated localities. Chironomids were the most numerous of the macroinvertebrates found in the litter bags and benthic samples; Tanytarsus pallidicornis, Ablabesmyia spp., Psectrocladius sordidellus, and P. septentrionalis dominated. Only one ephemeropteran, Leptophlebia vespertina, was found. Slow leaf degradation was attributed to a poor population of detritus grazers even after liming. Liming must be continued for a long time to allow immigrating species to colonize and begin to process leaf litter. (Cassar-PTT)
W88-06914

ZOOPLANKTON OF A SMALL TROPICAL RESERVOIR (SOLOMON DAM, NORTH QUEENSLAND),
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
P. R. Hawkins.
Hydrobiologia HYDRB8, Vol. 157, No. 2, p 105-118, January 15, 1988. 6 fig, 2 tab, 37 ref.

Descriptors: *Limnology, *Aeration, *Water pollution control, *Environmental effects, *Lakes, *Reservoir operation, *Tropical regions, *Zooplankton, Solomon Dam, Australia, Invertebrates, Water temperature, Temperature, Cyanophyta, Copepods, Cladocera, Rotifers, Copper sulfate, Algicides, Algae, Aeration.

A total of 54 zooplankton species were identified during sampling in Solomon Dam, on an island off the east coast of Australia. Rotifera were the most diverse taxonomic group (35 species), followed by Cladocera (13 species) and Copepoda (2 species). However, rotifers were of minor importance numerically, except in winter at water temperatures < 25 C. The copepod Mesocyclops notius was the only copepod present in the reservoir, and it was present perennially. This species was the dominant zooplankter because the adults were the largest organisms present and the species was frequently the most abundant. The age structure varied seasonally, with the ratio of nauplii to adults increasing at the beginning of winter mixing. Cladocerans were typical of an open water tropical zooplankton assemblage. Those appearing in highest densities were Ceriodaphnia cornuta, Moina micrura, Diaphanosoma sarsi, and Daphnia lumholtzi. Treatment of the reservoir water with copper sulfate (1.7 mg/liter Cu) to control algae killed almost all the invertebrate plankton. The first to appear, 14 days after the treatment, was the rotifer Brachionus calyciflorus. After a month cladocerans and copepods displaced the pioneer rotifer. Artificial aeration, which eliminated the large seasonal differences in water temperature, changed the population dynamics, as did reservoir flushing. Aeration also caused increases in diatom population and decreases in cyanobacteria, which in turn increased zooplankton density. (Cassar-PTT)
W88-06915

PCB AVAILABILITY ASSESSMENT OF RIVER DREDGING USING CAGED CLAMS AND FISH,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. P. Rice, and D. S. White.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 4, p 259-274, April 1987. 7 fig, 5 tab, 35 ref.

Descriptors: *Dredging, *Polychlorinated biphenyls, *River sediments, *Bioaccumulation, *Clams, *Minnows, *Contaminants, *Water pollution control, Bioavailability, On-site tests, Metabolism, Organic compounds, Bottom sediments, Monitoring, Tissue analysis, Aroclor, Shiawasse River, Michigan.

The effects of dredging to remove sediments contaminated with polychlorinated biphenyls (PCBs) were studied in South Branch of the Shiawassee River in south-central Michigan. Caged fingernail clams, Sphaerium striatinum (Lamarck), and fathead minnows, Pimephales promelas Rafinesque,

were used to monitor the bioavailability of PCBs, and these data were compared with changes in water column concentrations before dredging, during dredging and up to six months after dredging was completed. Monitoring of water, clams and fish during dredging confirmed that significant amounts of PCBs were released from the sediments. At all locations downstream and in the area of the dredging, there were increases in the availability of PCBs for at least six months. PCB concentrations in clams and fish in the dredged zone increased from 64.5 to 87.95 micrograms/g dry weight and from 13.82 to 18.30 micrograms/g dry weight, respectively, after dredging. Downstream (11 km), post-dredge uptake was also higher; however, clams showed less uptake than fish. This implied different uptake routes for the two organisms. There was no noticeable change in total PCB concentration in the water after dredging. In situ experiments were run to determine uptake curves and time to uptake equilibrium for both clams and fish. Results of tests for equilibrium uptake by fathead agreed with literature values. Uptake maxima occurred within 20 to 30 d. For clams, maximum uptake for Aroclor 1242 occurred after 9 d. Log bioconcentration factors for clams ranged from 2.6 to 4.5 for Aroclor 1242 and from 3.0 to 4.4 for Aroclor 1254; for fish, they ranged from 3.0 to 4.4 for Aroclor 1242 and from 4.5 to 5.5 for Aroclor 1254. (Author's abstract)
W88-06938

REGULATED FLUSHING IN A GRAVEL-BED RIVER FOR CHANNEL HABITAT MAINTENANCE: A TRINITY RIVER FISHERIES,
Battelle Memorial Inst., Denver, CO. Dept. of Environmental Sciences.
R. W. Nelson, J. R. Dwyer, and W. E. Greenberg.
Environmental Management EMNGDC, Vol. 11, No. 4, p 479-493, August 1987. 3 fig, 3 tab, 33 ref.

Descriptors: *Flushing, *Channel scour, *Channel morphology, *Fisheries, *Streamflow, *Dam effects, *Spawning, Channel loss, Stream improvement, Fish, Flood peak, Erosion, Salmon, Trout, Sedimentation, Trinity River, Trinity Dam, Lewiston Dam, California.

The operation of Trinity and Lewiston Dams on the Trinity River in northern California in the United States, combined with severe watershed erosion, has jeopardized the existence of prime salmonid fisheries. Extreme streamflow depletion and stream sedimentation below Lewiston have resulted in heavy accumulation of coarse sediment on riffle gravel and filling of streambed pools, causing the destruction of spawning, nursery, and overwintering habitat for prized chinook salmon (Salmo gairdnerii) and steelhead trout (Oncorhynchus tschawytscha). Proposals to restore and maintain the degraded habitat include controlled one-time remedial peak flows at annual maintenance peak flows designed to flush the spawning gravel and scour the banks, deltas, and pools. The criteria for effective channel restoration or maintenance by streambed flushing and scouring were examined here, as well as the mechanics involved. The liabilities of releasing mammoth scouring-flushing flows approximating the magnitude that preceded reservoir construction make this option unviable. The resulting damage to fish habitat established under the postproject streamflow regime, as well as damage to human settlements in the floodplain, would be unacceptable, as would the opportunity costs to hydroelectric and irrigation water users. The technical feasibility of annual maintenance flushing flows depends upon associated mechanical and structural measures, particularly instream maintenance dredging of deep pools and construction of a sediment dam with a limited useful economic life, combined with perpetual maintenance dredging, is questionable. (Author's abstract)
W88-06965

DETERMINING REGIONAL WATER QUALITY PATTERNS AND THEIR ECOLOGICAL RELATIONSHIPS,
Regional Air Pollution Control Agency, PO Box 972, Dayton, OH 45422.
For primary bibliographic entry see Field 7C.
W88-06967

MANAGEMENT STRATEGY FOR ACIDIC DEPOSITION IN WESTERN AND NORTHERN CANADA,
Alberta Dept. of Environment, Edmonton.
For primary bibliographic entry see Field 5B.
W88-06972

ANAEROBIC DEGRADATION OF ALKYLATED BENZENES IN DENITRIFYING LABORATORY AQUIFER COLUMNS,
Swiss Federal Inst. for Water Resources and Water Pollution Control, EAWAG, 6047 Kastanienbaum, Switzerland.
E. P. Kuhn, J. Zeyer, P. Eicher, and R. P. Schwarzenbach.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 2, p 490-496, February 1988. 5 fig, 3 tab, 40 ref. European Cooperation for Scientific and Technical Research Project COST 641.

Descriptors: *Water pollution treatment, *Groundwater pollution, *Toluene, *Aquifers, *Xylenes, *Mineralization, *Anaerobic conditions, *Biodegradation, *Microbial degradation, Microorganisms, Carbon radioisotopes, Organic compounds, Isotope studies, Oxidation.

Toluene and m-xylene were rapidly mineralized in an anaerobic laboratory aquifer column operated under continuous-flow conditions with nitrate as an electron acceptor. The oxidation of toluene and m-xylene was coupled with the reduction of nitrate, and mineralization was confirmed by trapping 14CO2 evolved from 14C-ring-labeled substrates. Substrate degradation also took place when nitrous oxide replaced nitrate as an electron acceptor, but decomposition was inhibited in the presence of molecular oxygen or after the substitution of nitrate by nitrite. The m-xylene-adapted microorganisms in the aquifer column degraded toluene, benzaldehyde, benzoate, m-toluylaldehyde, m-toluate, m-cresol, and p-hydroxybenzoate but were unable to metabolize benzene, naphthalene, methylcyclohexane, and 1,3-dimethylcyclohexane. Isotope-dilution experiments suggested benzoate as an intermediate formed during anaerobic toluene metabolism. The finding that the highly water-soluble nitrous oxide served as electron acceptor for the anaerobic mineralization of some aromatic hydrocarbons may offer attractive options for the in situ restoration of polluted aquifers. (Author's abstract)
W88-07011

TRANSFER AND EXPRESSION OF MESOPHILIC PLASMID-MEDIATED DEGRADATIVE CAPACITY IN A PSYCHROTROPHIC BACTERIUM,
Waterloo Univ. (Ontario). Dept. of Biology.
R. J. Kolenc, W. E. Inniss, B. R. Glick, C. W. Robinson, and C. I. Mayfield.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 638-641, March 1988. 3 fig, 1 tab, 33 ref.

Descriptors: *Water pollution treatment, *Water pollution control, *Wastewater treatment, *Genetic engineering, *Biodegradation, *Microbial degradation, *Psychrotrophic bacteria, *Bacterial physiology, *Microbiological studies, Plasmids, Aromatic compounds, Organic compounds, Enzymes.

A psychrotrophic bacterium, originally isolated from a natural aquatic environment, was characterized and identified as Pseudomonas putida Q5 for use as a representative recipient for biodegradative genes from a mesophilic microorganism. The TOL plasmid pWWO of the mesophile P. putida PaW1 was successfully transferred by conjugation to the naturally isolated psychrotroph P. putida Q5, as shown by plasmid analysis by agarose gel electrophoresis. Expression of the genes encoded by the mesophilic TOL plasmid in the psychrotroph was shown by the fact that the transconjugant (designed P. putida Q5T) had the capacity to degrade and utilize toluate (1,000 mg/liter) as a sole source of carbon at temperatures as low as 0 deg C. Comparison of growth rates over a wide temperature range (0 to 30 deg C) indicated that the physiological activity of the transconjugant was not reduced and that the plasmid DNA from the mesophile and its encoded enzymes functioned effectively in the psychrotroph at temperatures well below those at which the mesophile could grow. The production and demonstrated functioning of P. putida Q5T illustrates the possibility of developing specific degradative capacities in bacteria which can readily function at low temperatures in chemically contaminated environments or in industrial wastewater treatment systems. (Author's abstract)
W88-07017

PLANNING MODEL FOR OPTIMAL CONTROL OF SALTWATER INTRUSION,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 4B.
W88-07044

GROUNDWATER CONTAMINATION BENEFIT-COST ANALYSIS METHODOLOGY,
Jones and Henry Engineers Ltd., Toledo, OH.
K. K. Wolka, and T. A. Austin.
Journal of Water Resources Planning and Management(ASCE) JWRMD5, Vol. 114, No. 2, p 210-222, March 1988. 5 fig, 3 tab, 23 ref.

Descriptors: *Water pollution control, *Water pollution treatment, *Model studies, *Cost-benefit analysis, *Groundwater pollution, *Path of pollutants, Public health, Hydraulic permeability, Epidemiology, Statistical methods, Mathematical studies, Groundwater movement, Cleanup.

A procedure for estimating benefits associated with the cleanup of groundwater contamination was proposed. The first step in this procedure is development of a joint probability distribution of contaminant concentration and duration of exposure at a specified location X. A computer model using the turning bands method to generate spatially-varying, but correlated hydraulic conductivity fields and a groundwater flow/mass transport computer program to move the contaminant downstream was used to construct the probability distribution. The second step is involved with the formation of a joint incidence fraction distribution of test organism response to various contaminant concentration and duration of exposure levels at the specific location. The sum of the products of the joint probability and incidence fraction distribution values for various contaminant concentration and duration exposure levels are multiplied by the number of organisms exposed at the specified location in order to estimate benefits resulting from a groundwater cleanup effort. (Author's abstract)
W88-07046

SOUTH CAROLINA'S DIKED TIDAL WETLANDS: THE PERSISTING DILEMMAS,
South Carolina Univ., Columbia. Dept. of Government and International Studies.
M. E. Tompkins.
Coastal Management, Vol. 15, No. 2, p 135-155, 1987. 5 fig, 5 tab, 35 ref, append.

Descriptors: *South Carolina, *Coastal waters, *Wetlands, *Recreation, *Management planning, Public waters, Water resources development, Estuaries, Rice, Waterfront, Mosquito control.

South Carolina has a significant stock of diked coastal wetlands, dating from the days of rice culture before the Civil War. A survey of those parties, claiming, managing, or controlling these sites along the entire South Carolina coast reveals that many continue to be used for waterfowl hunting, with management practices becoming more intensive than they were when partial data were gathered a decade ago. It also suggests that most of the acreage involved is located in large fields, where management is more difficult and mosquito control problems are more likely. This survey also indicates that public access is limited, but that there is evidence of continuing conflict over ownership. This situation creates a persisting dilemma for coastal zone management, shaping conflicts between alternative strategies for the use of natural systems. (Author's abstract)

W88-07054

MANAGEMENT OF THE RIVER RHINE,
For primary bibliographic entry see Field 6B.
W88-07065

EQUILIBRIUM MODELS FOR SEASONAL DYNAMICS OF PLANKTON BIOMASS IN FOUR OLIGOTROPHIC LAKES,
British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
For primary bibliographic entry see Field 2H.
W88-07086

REDUCING GROUNDWATER POLLUTION BY TOXIC SUBSTANCES: PROCEDURES AND POLICIES,
Water Resources Research Center, University of Arizona, Tucson, Arizona.
M. Waterstone.
Environmental Management EMNGDC, Vol. 11, No. 6, p 793-804, November 1987. 5 tab, 39 ref.

Descriptors: *Cleanup, *Coastal estimate, *Management planning, *Water quality control, *Waste disposal, *Groundwater pollution, *Risks, Landfills, Industrial wastes, New Jersey, Public opinion.

A new concept of risk estimation is shown to produce more accurate and credible risk analyses for planning proper hazardous waste disposal. Two interrelated components of the waste disposal problem are (1) cleaning up abandoned disposal sites that pose actual or potential threats to water supplies and (2) planning future waste disposal sites and management. Cleanup costs have been estimated at up to $400 billion, whereas only $8.5 billion is presently available. Similarly, personnel, acceptable sites, and money are limited, requiring assignment of priorities. The method presented in this article is based on the concept of net risk, which considers both the objective risk as well as the response capability. It is applied to 212 municipalities in southern New Jersey. Measures of objective risk include vulnerability of source aquifer, total population and population change, vulnerable population (age considerations), and existing hazardous waste sites. The indicators for response capability are knowledge regarding the problem of drinking water contamination and the level of hazard awareness, knowledge of options available for dealing with toxic contamination of groundwater drinking supplies, actual response to similar situations in the past, and ability to implement adequate responses. Finally, the relationships between risk credibility and public perceptions of procedural fairness and equity are examined as these factors bear on the institutional aspects of implementing policies for site cleanup and/or facility siting. (Cassar-PTT)
W88-07102

FSC OIL POLLUTION RESEARCH UNIT--THE 1980S AND BEYOND,
Oil Pollution Research Unit, Orielton Field Centre, Pembroke, Dyfed SA71 5EZ.
B. Dicks.
Biological Journal of the Linnean Society BJLSBG, Vol. 32, No. 1, p 111-126, September 1987. 2 tab, 53 ref.

Descriptors: *Water pollution effects, *Oil spills, *Petroleum, *Estuaries, *Coastal waters, *Oil Pollution Research Unit, *Great Britian, Societies, Research, Oil pollution, Education, Conservation.

Research into the effects of oil contamination in estuaries and coastal waters has been the fundamental aim of Oil Pollution Research Unit since its inception in 1967. The development of the Unit's research program has taken place in response to the needs of government and industry. In recent years it includes moves into the international field and away from solely oil and marine projects. The accumulated research and educational experience has wide applications in future environmental monitoring, management and protection. Historically the research work of the Unit has been concentrated in the field. Although laboratory experimentation can provide valuable information regarding the effects of oil on marine organisms under controlled conditions, the philosophy is that effects on complex ecosystems can best be understood by study within these systems. This approach continues to form the basis of the major portion of the work, but laboratory analytical facilities and back-up programs have been developed to complement and extend the range of the field studies. A small but increasing proportion of the Unit's work has nothing to do with oil. The mid-70s saw a marked diversification of coastal surveys into the conservation field. The NCC has given the Unit considerable support for studying and evaluating coastlines which have been or may be proposed as Marine Nature Reserves under the terms of the 1981 Wildlife and Countryside Act. The approach has been to survey intertidal and subtidal areas for habitat and species distributions, evaluating conservation interest on criteria such as diversity, rarity, representativeness and fragility. Over the last five years much of the work has taken place in inlets of the south and west coasts of Britain. This work has led to the development of management plans for marine reserves for a number of areas. (Alexander-PTT)
W88-07128

APPLICATION OF MEMBRANES IN ENVIRONMENTAL PROTECTION,
Institute of Environmental Chemistry, Chinese Academy of Science, P.O. Box 934, Beijing, China.
For primary bibliographic entry see Field 5D.
W88-07218

OVERVIEW OF LANDFILL BOTTOM LINER HYDRAULICS,
Department of Civil Engineering, University of Patra, Patra, Greece.
For primary bibliographic entry see Field 5E.
W88-07277

PLANNING OF URBAN BEST MANAGEMENT PRACTICES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W88-07285

EFFECTS OF VARIABLE DISCHARGE SCHEMES ON DISSOLVED OXYGEN AT A HYDROELECTRIC STATION,
RMC-Environmental Services, 1921 River Road, P.O. Box 10, Drumore, Pennsylvania 17518.
D. Mathur, E. S. McClellan, and S. A. Haney.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 159-167, February 1988. 9 fig, 3 tab, 2 ref.

Descriptors: *Discharge flow, *Dissolved oxygen, *Hydroelectric power, *Water quality, *Chemical properties, *Water temperature, Meteorological factors, Oxygen depletion, Peaking plants, Run-of-the river plants, Susquehanna River, Maryland.

The effects of variable discharges during the summer on the dissolved oxygen (DO) content and water temperature upstream and downstream of the Conowingo Hydroelectric Power Station (Susquehanna River, Maryland) were investigated. The DO dynamics are controlled primarily by meterological factors that are independent of the mode of hydrostation operation. DO stratification occurred during the summer in Conowingo Pond, but thermal stratification was not observed. The magnitude and duration of off-peak discharges including a run-of-the-river operation did not affect DO stratification in Conowingo Pond; little vertical mixing occurred. However, strong winds and/or high river flows temporarily destroyed DO stratification. The run-of-the-river operation or off-peak continuous discharge schemes did not provide better DO conditions downstream of the hydrostation than the peaking operation with intermittent off-peak releases. (Author's abstract)
W88-07289

ALTERNATIVE TO WATER POLLUTION CONTROLS,
Villanova Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6F.
W88-07292

REMOVAL OF ORGANICS FROM LEACHATE BY THE COMBINED PROCESS OF A FACULTATIVE PRE-TREATMENT POND AND AN AERATED LAGOON AT A SEA-BASED SOLID WASTE DISPOSAL SITE,
Osaka City Inst. of Public Health and Environmental Sciences (Japan).
For primary bibliographic entry see Field 5D.
W88-07330

ATTENUATION OF UNDERGROUND WATER CONTAMINATION IN A VINASSE CLAY-LINED POND,
Dept. of Chemical Engineering, Sao Paulo University, P.O. Box 8178, Sao Paulo, SP, 01000, Brazil.
For primary bibliographic entry see Field 5D.
W88-07341

STRETCHING THE SYSTEM: THE CHALLENGE OF GROUNDWATER PROTECTION,
Resources for the Future, Inc., Washington, DC.
R. W. Fri.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 300-304, March 1988.

Descriptors: *Groundwater pollution, *Environmental protection, *Regulations, *Environmental control, Nonpoint pollution sources, Water pollution sources, Economic aspects, Legal aspects.

In this commentary, it is asserted that today's environmental management problems are scientifically vastly more complicated than those encountered in the early days of the U.S. Environmental Protection Agency. The problems have changed in such fundamental ways that they raise questions as to whether our current system of law and regulation can work effectively or credibly. These problems may even exceed the limits of our current ability to understand them scientifically, economically, or politically. To illustrate these points, three emerging water pollution problems are examined through the eyes of a scientist, an economist, and a politician, namely, point source pollution, nonpoint source pollution, and groundwater pollution. (Sand-PTT)
W88-07415

CLEAN WATER ACT: NPDES PERMIT STRATEGIES,
J. M. Zorc, C. L. Rissetto, G. B. Cohen, and R. L. Raider.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 3, p 309-315, March 1988. 29 ref.

Descriptors: *Water pollution control, *Clean Water Act, *Legal aspects, Standards, Permits, Regulations, Federal jurisdiction, State jurisdiction.

Clean Water Act (CWA) compliance, judicial and administrative enforcement actions have been made easier to prosecute, and their results significantly more costly to permitees, by the recent passage of the Water Quality Act of 1987 (WQA). Methods exist to deal with apparent prior (and current) National Pollutant Discharge Elimination System (NPDES) permit exceedance events and significantly avoid circumstances of future noncompliance, while achieving meaningful cost savings. States increasingly share in directing CWA permitting and enforcement. Congress, consistent with prevailing notions of federalism, authorized states to assume the NPDES permitting authority after certain prescribed standards were met. The Environmental Protection Agency (EPA), even after NPDES delegation to a state, continues to have permit review and enforcement roles. This duality has raised several important problems, including the extent to which EPA can second-guess a state agency. (Sand-PTT)
W88-07416

SIMULATED RESPONSE OF AN ACIDIC ADIRONDACK LAKE WATERSHED TO VARIOUS LIMING MITIGATION STRATEGIES,
Science and Policy Associates, Inc., Washington, DC.
J. E. Davis, and R. A. Goldstein.
Water Resources Research WRERAO, Vol. 24, No. 4, p 525-532, April 1988. 9 fig, 46 ref.

Descriptors: *Model studies, *Limnology, *Watersheds, *Water quality, *Liming, *Adirondacks, Hydrogen ion concentration, Alkaline water, Water chemistry, Catchment areas, Lakes, Woods Lake, Aluminum, Acid rain effects.

The Integrated Lake Watershed Acidification Study model was modified to accept pulse inputs of calcium carbonate dry deposition on user-specified dates and over selective areas of the Woods Lake watershed. Responses at the lake outlet and in several soil horizons in the catchment were simulated for various liming scenarios comparing separate applications to both lake and land surfaces, during both spring and winter seasons, and at two different dose levels over the land area. The direct lake application was characterized by large, immediate, short-duration increases in lake outlet pH and alkalinity, attributable to a sudden influx of alkaline material that quickly flushed through the aquatic system. The terrestrial application was characterized by lower magnitude, more gradual and longer duration increases in both lake outlet, and soil pH and alkalinity, attributable to enhancement of the base saturation at soil cation exchange sites. Inorganic aluminum concentrations, a concern with respect to fishery health, were only temporarily reduced following the lake application, while dramatic reductions were sustained for several decades following the terrestrial application; this suggests terrestrial liming slows the rate of chemical weathering and leaching of aluminum. The seasonal timing of the lime application significantly affected the magnitude and duration of the response in the lake application, but not in the land treatment, suggesting that the effectiveness of land treatment may not depend on seasonal flow dynamics. In addition, this indicates that mean hydraulic residence time may have certain limitations as an indicator of the retention time of chemical species introduced to an entire watershed, depending on the extent to which the land catchment influences adjacent water chemistry. These results suggest that for lakes and streams having short retention times, liming part or all of the land catchment might be advantageous to liming only the lake as a means of mitigating lake acidity. This conclusion and the potential for concurrent mitigation of terrestrial effects employing land catchment liming requires further experimental study. (Author's abstract)
W88-07442

APPLICATION OF NONLINEAR OPTIMIZATION TO WATER QUALITY,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
D. H. Burn, and E. A. McBean.
Applied Mathematical Modeling AMMODL, Vol. 11, No. 6, p 438-446, December 1987. 1 fig, 5 tab, 15 ref.

Descriptors: *Decision making, *Water pollution prevention, *Water quality, *Uncertainty, *Optimization, *Wastewater treatment, *Mathematical models, Mathematical studies, Pollution load.

Two formulations for nonlinear optimization (minimize variance and fractile programming formulations) are presented for the solution of water quality planning problems. The optimization algorithms were applied to the problem of determining the optimal waste removal to mitigate the deleterious impacts of the waste discharges on the dissolved oxygen concentration in the Schuylkill River. The pollutant loading and transport in the stream were considered as random variables with the first two moments of the resulting distributions included in the models. The alternative model formulations would allow a decision maker to select the model interpretation that best suits the decision maker's preference. The trade-offs would allow the decision maker to choose between conflicting objectives, such as cost and the mean water quality level attained in the system. (Freidmann-PTT)
W88-07492

MATHEMATICAL MODEL FOR LEAK LOCATION IN PIPELINES,
Department of Mechanical Engineering, Cairo University.
A. H. A. Baghdadi, and H. A. Mansy.
Applied Mathematical Modeling, Vol. 12, No. 1, p 25-30, February 1988. 9 fig, 1 tab, 16 ref. USAID contract nos. NE-C-1291 and 263-0061-C00-1001-00.

Descriptors: *Leakage, *Pipelines, *Conveyance structures, Mathematical models, Water transport, Structural behavior, Structural models, Pipes.

A method for leak detection in pipelines is based on a unidimensional flow analysis. The theoretical findings have been verified experimentally for two different hole geometries (circular and rectangular). The comparison between theory and experiment confirms the physical realism of the mathematical model. The accuracy in calculating the leak position is estimated to be less than a few percent for the different hole geometries in question. Although this work was carried out for the case where the leak is spouting to the atmosphere, it can be applied to the analysis of submerged pipelines, as well as to pipes carrying compressible fluids or a two-phase flow mixture, and to cases of single-phase incompressible flow in a pipe network. (Author's abstract)
W88-07494

STUDIES ON REMOVAL OF MALATHION FROM WATER BY MEANS OF ACTIVATED CHARCOAL,
Aligarh Muslim Univ. (India). Chemistry Section.
For primary bibliographic entry see Field 5F.
W88-07497

EVALUATION OF THE GREAT LAKES NEARSHORE INDEX,
Dept. of Environmental Health, College of Public Health, P.O. Box 26901, Oklahoma City, OK 73190.
For primary bibliographic entry see Field 2H.
W88-07537

PHOSPHORUS RELEASE FROM THE PEATY SEDIMENTS OF THE LOOSDRECHT LAKES (THE NETHERLANDS),
Limnological Institute, Vijverhof Laboratory Rijksstraatweg 6, 3631 AC Nieuwersluis, The Netherlands.
P. C. M. Boers, and O. van Hese.
Water Research WATRAG, Vol. 22, No. 3, p 355-363, March 1988. 8 fig, 3 tab, 25 ref.

Descriptors: *Water pollution treatment, *Lakes, *Path of pollutants, *Phosphorus, *Sediments, *Peat, Seasonal variation, Loosdrecht Lakes, Netherlands, Shallow lakes, Organic matter, Eutrophication, Mineralization, Model studies, Chemical precipitation, Water temperature, Temperature.

Seasonal patterns in phosphorus release from sediments of the Loosdrecht Lakes were studied in the laboratory in a continuous flow system. The highest release rates (up to 4 mg P/sq m/day) were found in August and the lowest (0.2 mg P/sq m/day) in winter. Temperature was the most important factor controlling release; only temperatures 13 C allowed release in summer. An infiltration rate of 10 mm/day suppressed the P-release effectively. A pH of 9.5 instead of 8.2 in the overlying water had only a minor effect on release rates. Release rates based on a preliminary phosphorus budget calculated for 1984 and those measured in the laboratory were comparable. A conceptual model based upon mineralization and precipitation processes was employed to explain the results obtained. The observed influences of temperature, infiltration, and pH of the water column were explained qualitatively by the model. An effect of changes in oxygen penetration depth on phosphorus release rates cannot be excluded. (Author's abstract)
W88-07548

UPCOMING REGULATIONS: HOW THEY WILL AFFECT THE WATER INDUSTRY,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 6E.
W88-07654

REVIEW OF NEW YORK'S SECTION 208 WATER QUALITY MANAGEMENT PLAN AND PENNSYLVANIA'S COMPREHENSIVE WATER QUALITY MANAGEMENT PLAN FOR INTERSTATE STREAMS,
Susquehanna River Basin Commission, Harrisburg, PA.
C. Takita.
Publication No. 98. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. July 1985. 41 p, 16 fig, 14 tab, 3 ref. EPA Grant No. I-003992-85.

Descriptors: *Water quality management, *Pennsylvania, *New York, *Susquehanna River Basin, *Chemung River basin, *Interstate rivers, *Regulations, *Management planning, Water pollution sources, Nonpoint pollution sources, Land use, Water quality.

The Susquehanna River Basin Commission staff reviewed the Water Quality Management and Section 208 Plans for Pennsylvania and New York to assure compatibility of the respective plans within interstate watersheds. The point source and nonpoint source management recommendations were found to be compatible. Stream use classifications for upstream and downstream segments were also found to be compatible. Presented are summaries of land uses, and water quality and point source recommendations for the Cascade Creek, Denton Creek, Trowbridge Creek, Snake Creek, Little Snake Creek, Choconut Creek, Appalachin Creek, Wappasening Creek, Sackett Creek, Park Creek and Cayuta Creek watersheds in the Susquehanna River subbasin. Similar summaries are provided for Bentley Creek, Seeley Creek and Tioga River watersheds in the Chemung River subbasin. Nonpoint source recommendations are discussed in general for all watersheds. A brief discussion of the existing discharges and water quality of the Susquehanna River and the Chemung River are also provided. (Author's abstract)
W88-07717

WATER QUALITY AND BIOLOGICAL SURVEY OF THE JUNIATA RIVER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07720

ANNUAL REPORT: 1984.
For primary bibliographic entry see Field 6E.
W88-07731

ANNUAL REPORT: 1985.
For primary bibliographic entry see Field 6E.
W88-07732

ANNUAL REPORT: 1986.
For primary bibliographic entry see Field 6E.
W88-07733

ANNUAL REPORT: 1982.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6E.
W88-07734

CHESAPEAKE BAY DATA BASE: DOCUMENTATION OF HISTORICAL DATA IN THE LOWER SUSQUEHANNA RIVER BASIN,

Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 7C.
W88-07736

STREAM SAMPLING FOR WASTE LOAD ALLOCATION APPLICATIONS,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5E.
W88-07753

FIELD DISPERSANT EFFECTIVENESS TEST,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
A. Diaz.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234886. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-87/072, August 1987. 41 p, 13 fig, 7 tab, 6 ref, 2 append. EPA Contract No. 68-03-3203.

Descriptors: *Dispersants, *Path of pollutants, *Water pollution treatment, *Oil spills, *Oil pollution, Field tests, Fate of pollutants, Marine environment, Databases, Water pollution control.

The EPA's OHMSETT facility has developed a rapid field test that includes some of the theoretical aspects and conditions of dispersion at sea. This Field Dispersant Effectiveness Test (FDET) has been used to evaluate the dispersibility of various commonly transported oils and make a database for dispersant selection and application. The FDET was designed to generate droplet sizes that closely resemble the dispersion of oil occurring at sea. A fixed mixing intensity and time induces the effects necessary to produce the dispersion and reveal the effectiveness of the dispersant and dispersibility of the oil. The measurement of the dispersibility of various crude oils with several dispersants have been incorporated into a database. This data will help the officials involved in the control of oil spills to make more informed decisions about the use of dispersants. (Author's abstract)
W88-07755

EXECUTIVE SUMMARY OF LONG-RANGE ENVIRONMENTAL MANAGEMENT PLANS, FY 1987-1993,
Martin Marietta Energy Systems, Environmental and Safety Activities Organization.
For primary bibliographic entry see Field 6A.
W88-07761

RISK ASSESSMENT AND CONTROL DECISIONS FOR PROTECTING DRINKING WATER QUALITY,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
J. A. Cotruvo.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 693-733, 5 fig, 4 tab, 47 ref.

Descriptors: *Drinking water, *Water quality, *Risk assessment, *Standards, Chemical analysis, Water quality management.

Risk evaluation processes, as they have been applied to drinking water standards and guidelines, are described. Traditional risk assessments and standards are based upon single chemical toxicology. They typically assume that no significant interactions occur at the low levels at which chemicals are commonly found in the environment. Newer evaluation techniques might permit development of standards based upon indications of hazard from exposure to the actual environmental mixtures. New concentration techniques and biological indicator measurements will be the keys to this possible innovation in water regulation. If improvements are expected in the ability to assess risks from the consumption of drinking water, concentrates from several sources of varying quality (including reuse systems) should be tested by these techniques to determine relative qualities of these waters and to compare the results with single toxicology predictions. Numerous calculation models have been suggested but none have a strong biological basis and none are verifiable in the range of environmental exposure which can be six orders of magnitude below animal test dose. Model selection will have a profound effect on lose-dose risks. The one-hit or linear multistage models should be used because they are usually among the more conservative procedures. (See also W88-07783) (Author's abstract)
W88-07817

GUIDELINES FOR CANADIAN DRINKING WATER QUALITY,
Health and Welfare Canada, Tunney's Pasture, Ottawa (Ontario). Health Protection Branch.
P. Toft, M. Malaiyandi, and J. R. Hickman.
IN: Organic Pollutants in Water: Sampling, Analysis, and Toxicity Testing. Advances in Chemistry Series, No. 214. American Chemical Society, Washington, DC. 1987. p 735-750, 7 tab, 13 ref.

Descriptors: *Standards, *Canada, *Drinking water, *Water quality, Coliforms, Pesticides, Inorganic compounds, Organic compounds, Heavy metals.

The development of the guidelines for drinking water in Canada is described. These guidelines are compared with guidelines published by the World Health Organization in 1984, and recommended limits are given (in tabular form) for pesticides, trace elements, organic compounds, physical characteristics of drinking water, and inorganic substances. The guidelines provide the following recommendations with respect to microbiological contamination of drinking water: (1) No sample should contain >10 coliform organisms/100 ml; (2) Not more than 10% of the samples taken in a 30-day period should show the presence of coliforms organisms; (3) Not more than two consecutive samples from the same site should show the presence of coliform organisms; and (4) None of the coliform detected should be fecal coliform. The objective limit is that no organisms should be detected/100 ml of the sample. (See also W88-07783) (Lantz-PTT)
W88-07818

AGRICULTURAL MANAGEMENT AND WATER QUALITY.
Iowa State University Press, Ames, Iowa. 1983. 472 p. Edited by Frank W. Schaller and George W. Bailey.

Descriptors: *Agriculture, *Water quality management, *Water quality control, Conferences, Nonpoint pollution sources, Model studies, Research priorities, Mathematical studies, Water quality, Public policy, Environmental protection, Acid rain.

In May 1981 a national conference entitled 'Agricultural Management and Water Quality' was held at Iowa State University to present, discuss, and disseminate information on water quality and agricultural nonpoint source pollution problems and their management. A major objective was to review the latest research and field experience in these areas. The papers presented at the conference are published in this book. The conference was organized into five main sessions, each of which was concerned with a different theme. In Session 1 two papers reviewed key issues of agricultural nonpoint source pollution from both the environmental and agricultural perspective. In Session 2 seven papers were presented. The first reviewed research and development activities over the last four decades with emphasis on modeling agricultural nonpoint source pollution. The remaining six papers discussed nonpoint source pollution problems and processes related to nitrogen, phosphorus, pesticides, and animal waste. One paper addressed atmospheric deposition of nutrients and pesticides to land surfaces with implications to the acid rain issue. In Session 3 five papers were devoted to modeling techniques used to predict pollutant loads and water quality impacts. Mathematical models were presented and evaluated for usability, accuracy, and limitations. Session 4 addressed the role of Best Management Practices (BMPs) in controlling nonpoint source pollution. Finally, in Session 5 policy issues and trends on both a re gional and national basis were discussed, including a review of trends in agricultural and possible environmental futures. Three papers summarizing key points an identifying research needs concluded the conference. (See W88-07821 thru W88-07842) (Lantz-PTT)
W88-07820

ENVIRONMENTAL PROBLEMS AND ISSUES OF AGRICULTURAL NONPOINT SOURCE POLLUTION,
Environmental Research Lab., Athens, GA. Office of Research and Development.
D. W. Duttweiler, and H. P. Nicholson.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 3-16, 2 fig, 1 tab, 45 ref.

Descriptors: *Agriculture, *Nonpoint pollution sources, *Environmental protection, *Water pollution sources, *Water quality, Pesticides, Agricultural chemicals, Public policy, Social aspects, Water quality management.

Modern agriculture in the United States is recognized by many farmers and most environmentalists as a significant source of water pollution. Eroded soil, agricultural chemicals applied to land for pest control or for plant nutrition, and wastes from animal and plant production can adversely affect water quality when they reach surface or ground waters in excessive amounts. Water pollution from these agricultural activities is a complex social problem that continues to challenge government, agribusiness, environmentalists, and the concerned public. Considerable progress has been made, but much remains to be done to assure the quality of the nation's essential water resources and the viability of its food suppliers. A systematic, integrated approach to managing water resources and agricultural systems in harmony with water quality and quantity objectives is needed. Specific social issues, such as the implementation of BMPs or the preservation of sufficient agricultural lands, must be successfully addressed before the environmental problems of agriculture can be considered solved. (See also W88-07820) (Lantz-PTT)
W88-07821

AGRICULTURAL PROBLEMS AND ISSUES AS RELATED TO AGRICULTURAL MANAGEMENT PRACTICES AND WATER QUALITY,
Iowa Agricultural and Home Economics Experiment Station, Ames.
J. P. Mahlstede, and T. E. Hazen.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 17-24, 5 ref.

Descriptors: *Agriculture, *Water quality management, *Agricultural practices, Soil conservation, Technology, Water quality control, Water quality, Economic aspects, Social needs, Legal aspects, Political constraints.

This overview focuses on problems and trade-offs associated with the goal of insuring sustainable agricultural production systems while improving water quality. Obviously these problems and trade-offs are not confined simply to a development of agricultural technologies. They include economic, social, legal, and political constraints that are necessary for the security and maintenance of the ecological resource base required for plant growth and development. Restoring environmental quality via soil conservation, water quality and technology impact studies, are discussed directly. (See also W88-07820) (Lantz-PTT)
W88-07822

TRANSFORMATIONS AND TRANSPORT OF NITROGEN,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W88-07824

CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Lab.
W. G. Knisel, G. R. Foster, and R. A. Leonard.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 178-199, 6 fig, 6 tab, 22 ref.

Descriptors: *CREAMS, *Water quality management, *Water pollution sources, *Mathematical models, Nonpoint pollution sources, Water quality control, Hydrology, Erosion, Sediment yield, Path of pollutants, Runoff, Nutrients, Pesticides, Simulation analysis, Sediments, Management planning.

Mathematical models to assess nonpoint source pollution and evaluate effects of management practices for its control are needed to adequately respond to water quality legislation of the past 10 years. Consequently, the USDA Science and Education Administration Agricultural Research has developed CREAMS, a field scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The model includes components for hydrology, erosion/sediment yield, and chemical transport that describe the movement of runoff, sediment, and its characteristics, plant nutrients, and pesticides from field-sized areas. It is a continuous simulation model that operates efficiently to allow consideration of long records (20 yr). The model is used to evaluate alternate management practices for impact on the yield of sediment and chemical pollutants from field-sized areas at specific sites. A number of these alternate practices can be proposed for a site, and after their evaluation with CREAMS, a practice can be chosen from those judged to adequately control sediment and chemical yield. (See also W88-07820) (Lantz-PTT)
W88-07831

PREDICTING WATER QUALITY RESULTING FROM AGRICULTURAL NONPOINT SOURCE POLLUTION VIA SIMULATION - HSPF,
Anderson-Nichols and Co., Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5B.
W88-07832

EVALUATING THE EFFECTIVENESS OF BMPS FROM FIELD STUDIES,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. L. Baker, and H. P. Johnson.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 281-304, 1 fig, 7 tab, 60 ref. Iowa Agriculture and Home Economics Experiment Station Project No. 2450.

Descriptors: *Water quality management, *Management planning, *Field tests, Path of pollutants, Fate of pollutants, Mathematical models, Research priorities, Chemical properties, Physical properties, Agriculture, Soil-water-plant relationships, Weather, Sediment transport, Pollution load, Sediment load, Biological filters, Ecological effects, Agricultural runoff.

Chemical and physical factors influencing the effectiveness of Best Management Practices (BMPs) are considered, methods of determining BMP effectiveness from field studies are discussed, and a review of the results of BMP studies are presented. Enough understanding of the basic processes involved in the transport and fate of agricultural chemicals has been generated that logic and/or mathematical modeling normally can be used to qualitatively predict the effects of different practices. However, the large number of different chemicals involved and the complexity and variation with time and space of the soil-water-plant-weather system make the field study of all possible combinations improbable and the quantitative translation of results from one set of conditions to another very difficult. Relative to environmental concerns, however, two other areas of research probably should have higher priority. First, the ability to predict edge-of-field losses far exceeds current understanding of the field-to-stream transport processes. Research is needed to obtain background experimental data and increased understanding of sediment transport and changes in chemical and hydrologic processes that occur en route. In particular, the use of vegetative buffers or filter strips has environmental control potential and warrants further study. The second major deficiency is a lack of knowledge of the biological impact of chemical and sediment loads on the quality of water resources receiving agricultural drainage. Currently, some practices (e.g., incorporation of pesticides) are being promoted as BMPs because they reduce edge-of-field chemical losses and, presumably, the amount of chemicals reaching the water resources. However, little may be known of the impact of the presence of the chemical in question. It is evident from the experimental data which were reviewed that two of the leading BMP candidates to reduce edge-of-field runoff losses are conservation tillage and incorporation of applied chemicals - the first reduces sediment and water carriers, the second, chemical concentrations. (See also W88-07820) (Lantz-PTT)
W88-07835

AGRICULTURAL MANAGEMENT PRACTICES AND THE INTEGRITY OF INSTREAM BIOLOGICAL HABITAT,
Iowa State Univ., Ames. Dept. of Animal Ecology.
B. W. Menzel.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 305-329, 3 fig, 4 tab, 98 ref. Iowa Agriculture and Home Economics Experiment Station Project No. 2410.

Descriptors: *Stream biota, *Aquatic habitat, *Water quality management, *Agricultural practices, Nonpoint pollution sources, Ecosystems, Ecological effects, Nutrients, Sediment yield, Flow profiles, Habitats, Energy, Soil conservation, Agricultural chemicals, Riparian land, Water storage, Water temperature, Dissolved oxygen.

To date, the principal approach of agricultural nonpoint source pollution control programs has been to employ traditional and sometimes innovative soil and water conservation practices in the expectation that reduction of sediment and of at least some agricultural chemical inputs will be sufficient to restore water quality and thereby achieve stream ecological integrity as well. Long-term studies have made important contributions to the knowledge of stream ecology in agricultural ecosystems. From these investigations, a holistic Best Management Systems approach has been advanced to achieve both agricultural production and ecological integrity objectives. This system approach would utilize a variety of land and water management strategies, designed to meet specific local conditions, in order to produce acceptable compromises between productive and protective uses of the resources. Although a variety of approaches is possible, a unifying element in each is the protection of substantial proportions of riparian environments. Some recommended practices for achieving improvements in the four contributing elements of stream ecological integrity are: (1) Water quality - For reduction in sediment and nutrient loading, traditional soil conservation practices will be of utility to varying degrees; (2) Flow regime - For reduction of discharge extremes, practices promoting storage of storm runoff, followed by water release during dry periods, are suggested; (3) Habitat structure - Active programs of structural habitat improvement are possible but tend to be labor-intensive and expensive; and (4) Energy relationships - In addition to promoting improved water quality, flow regime, and habitat structure, maintenance of a riparian buffer strip would provide a source of nutritive detrital material and enhance conditions of temperature and dissolved oxygen by reducing direct solar radiation. (See also W88-07820) (Lantz-PTT)
W88-07836

FRAMEWORK FOR SELECTING AGRICULTURAL NONPOINT SOURCE CONTROLS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
P. D. Robillard, and M. F. Walter.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 330-348, 10 fig, 6 tab, 35 ref.

Descriptors: *Planning, *Water pollution control, *Agricultural practices, *Nonpoint pollution sources, *Water quality management, Water quality control, Costs, Pollutant loads, Land use, Agriculture, Cost analysis, Economic aspects.

Considerable progress has been made in linking nonpoint source loads to water quality objectives for specific stream/lake systems such as the Great Lakes. However, in many watersheds, generalized nonpoint pollution sources (NPS) planning will probably continue with minimal data. The planning framework presented in this paper is intended for the latter case. Utilizing the concepts of pathway control, manageable NPS load, cost-effectiveness, and cost equivalents, control strategies can be evaluated. This evaluation procedure will yield a ranking of different types of practices or sets of practices. The results of the case study and the example of NPS control strategy evaluation support and highlight the following findings from previous research activities: (1) Management and tillage options, in some cases, offer cost-effective NPS control options; (2) Agricultural NPS controls which take land out of production or result in a shift from relatively high value row crops to small grains or sod can have appreciable income effects; (3) By integrating point source or nonagricultural NPS control alternatives into the evaluation framework, a standard for comparison can be established. In some instances, point source controls are clearly more efficient and overall program resources should be redirected accordingly; and (4) Treating high delivery or critical areas can appreciably reduce unit NPS control costs. More intensive land treatment utilizing vegetative and structural controls may be justified in these cases. (See also W88-07820) (Lantz-PTT)
W88-07837

SOCIAL AND INSTITUTIONAL FACTORS AFFECTING THE ADOPTION AND MAINTENANCE OF AGRICULTURAL BMPS,
Iowa State Univ., Ames. Dept. of Sociology and Anthropology.
P. J. Nowak, and P. F. Korsching.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 349-373, 2 fig, 5 tab, 64 ref. Iowa Agriculture and Home Economics Experiment Station Project No. 2364.

Descriptors: *Water quality control, *Social aspects, *Management planning, *Agricultural practices, *Institutions, *Best Management Practice, Land use, Conservation, Nonpoint pollution sources, Topography, Soil conservation.

Best Management Practices (BMPs) may be considered among the technologies that have the potential to enhance environmental quality. They provide an alternative combination of land use, conservation practices, and management techniques which, when applied to a unit of land, result in the opportunity for a reasonable economic return within acceptable environmental standards. Nevertheless, even though these BMPs exist and are being continually refined and improved, there has been only marginal success in their implementation. Their potential benefit will only become real to the extent that they actually are implemented. This paper analyzes the social and institutional factors that influence the adoption and maintenance of agricultural nonpoint source BMPs by farmers and landowners. The role of institutional factors, topographic characteristics of the land, structure of the farm organization, and personal characteristics of the farm operator will be discussed relative to their influence on behaviors which have the potential to enhance water quality and conserve the soil. (See also W88-07820) (Lantz-PTT)
W88-07838

BEST MANAGEMENT PRACTICE IMPLEMENTATION ECONOMICS AND FARMER DECISION MAKING,
Iowa State Univ., Ames. Dept. of Economics.
J. A. Miranowski, and K. F. Alt.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 374-384, 2 fig, 4 tab, 2 ref.

Descriptors: *Farming, *Decision making,*Best Management Practice, *Economic aspects, *Agricultural practices, *Management planning, Economic aspects, Energy, Tillage, Nonpoint pollution sources, Risks, Profit.

The objective of Best Management Practice (BMP) implementation economics is to forecast which BMPs will be selected by farmers for implementation and to aid farmers in that selection process. This evaluation has generally relied on comparisons of monetarized costs and benefits of alternative BMPs, such as can be done by budget analysis or linear programming. A major point of discussion needs to be how closely these decision models for determining BMP economics will represent the decision-making process of farmers. Traditional analyses of BMPs are restricted by the assumptions employed. Farmers may entertain objectives in addition to profit maximization. Farm management decisions may involve intertemporal soil productivity. The regional programming model coefficients are not scaled up from coefficients developed for individual farm models. Also, much information may be lost in going from actual farmers to representative farmers. Farmers' perceptions of yields and risk need to be considered in modeling. Although the sample farmers' yield perceptions were not significantly different from research evidence, their risk attitudes were not homogeneous, but varied from risk averse to risk loving. Economic characteristics of farmers may be important in BMP adoption and utilization, especially if conservation programs are to be targeted to specific erosion problems and to particular farmers. The choice of tillage practice was sensitive to human capital, scale, and tenure factors. Relative input (energy) price changes also need to be considered when developing non-point source pollution policies. Rising energy prices will reduce soil loss to a point. Further reductions will have to rely on other regulatory or incentive programs. (See also W88-07820) (Lantz-PTT)
W88-07839

POLICY DEVELOPMENT AND THE REGIONAL ECONOMICS OF IMPLEMENTING NPS CONTROLS,
Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.
C. R. Taylor.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 387-402, 6 fig, 5 tab, 10 ref.

Descriptors: *Water pollution control, *Nonpoint pollution sources, *Management planning, *Economic aspects, *Policy making, Farming, Comparison studies, Cost-benefit analysis, Costs, Model studies, Social costs.

The conceptual framework for policy evaluation highlights the necessity for considering the market as well as the pollution impacts of regional and national policies. For policies which impact a significant portion of national production it was shown that farm income as well as pollution paradoxes exist. Due to the interactive nature of nonpoint pollution source (NPS) policies arising from market forces or physical factors, it was shown that NPS policies on different sources should be evaluated together in arriving at a comprehensive NPS policy. Moreover, interregional linkages must be considered in the policy development stage because a policy imposed in one region influences the impacts of a policy in another region. Development of a regional or national model for analysis of NPS policies necessitates many modeling compromises in terms of market and noneconomic linkages. A comparison of several similar studies of erosion-sedimentation control policies yielded the observation that the studies had many conflicting results, especially in terms of identifying who gains and who loses from establishment of a particular policy. However, there is some comfort in the fact that the various studies gave reasonably consistent estimates of the social cost of policies as manifested in the marketplace. To complete the social accounting of benefits and costs, estimates of the external (pollution) costs abated by the policies and of the social overhead (public) costs are required. Neither of these cost categories have been given enough attention. (See also W88-07820) (Lantz-PTT)
W88-07840

NATIONAL MODELING AND POLICY ANALYSIS OF AGRICULTURAL NONPOINT SOURCE CONTROL OPTIONS,
Resources for the Future, Washington, DC. Environmental Policy Evaluation Program.
L. P. Gianessi.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 403-424, 6 fig, 3 tab, 31 ref. NSF Grant No. SOC 77-15045.

Descriptors: *Policy making, *Model studies, *Nonpoint pollution sources, *Water pollution control, Agricultural practices, Nitrogen, Phosphorus, Biological oxygen demand, Dissolved oxygen, Sediment control, Simulation analysis, Water quality control, Runoff, Kjeldahl procedure, Water quality standards, Cropland, Rivers.

Rivers and regions of the country where cropland sediment controls will result in significantly improved water quality are identified. The baseline simulations indicate widespread violations of total Kjeldahl nitrogen (TKN) and total phosphorus (TP) water quality standards. Violations of BOD and DO standards are significantly lower. These results are in agreement with the latest water quality monitoring data available for the nation. The report shows the results of three policy simulations: a point source control policy Best Practicable Technology Standards/Secondary Treatment (BPT/ST), a cropland sediment control policy, and full implementation of the first two policies. The simulations indicate that the first two policies by themselves would result in varying degrees of water quality improvement nationally. However, full implementation of these two policies would result in significantly improved water quality in many regions of the country. The report shows that such a policy would further reduce water quality violations over and above the reduction that could be expected by point source controls alone by the following percentages: 31% for BOD, 24% for TKN, 25% for TP, and 44% for DO. Even after full implementation of point source and sediment control policies, however, approximately one-half of the nation's rivers will still experience violations of the TP and TKN standards. This analysis suggests that attention will have to be given to reducing other nonpoint sources of these pollutants, such as pastureland, rangeland, and urban runoff. (See also W88-07820) (Lantz-PTT)
W88-07841

TRENDS IN AGRICULTURE AND POSSIBLE ENVIRONMENTAL FUTURES,
Resources for the Future, Inc., Washington, DC.
P. Crosson.
IN: Agricultural Management and Water Quality. Iowa State University Press, Ames, Iowa. 1983. p 425-452, 6 tab, 40 ref.

Descriptors: *Agricultural practices, *Water pollution control, *Future planning, *Environmental effects, Animal wastes, Crops, Fertilizers, Pesticides, Research priorities, Economic aspects, Erosion control, Policy making, Grain crops, Soybeans, Cotton, Technology, Prices, Crop yield, Cropland, Soil erosion, Soil conservation, Herbicides.

The economic and environmental impacts of projected growth in US crop production and alternative policies for dealing with these impacts, are discussed, focusing on grains, soybeans, and cotton. There crops regularly occupy some 70% of harvested cropland and are by far the major users of fertilizers and pesticides applied by farmers. Moreover, these are the crops for which demand is likely to grow most rapidly. Wastes of confined animals are an important source of water pollution, but most of it is counted as a point source. The concern here is with the impacts of nonpoint sources of agricultural wastes. The paper is divided into six parts dealing with projects of crop production; trends in technology, input prices, and crop yields; demand and supply projects for cropland; future demand for fertilizers and pesticides; environmental impacts of the projected patterns of resource use; and policy issues suggested by the analysis of environmental impacts, respectively. In thinking about how to cope with the projected erosion problem, new approaches are needed. The author suggests that research to develop new technologies that would deliver higher crop yields than those projected would go far to reduce the demand for cropland, permitting production to be concentrated on the best, less erosive lands. In addition, research to overcome the present economic and environmental limits to conservation tillage would permit more erosive land to be brought into production without paying the high penalty in erosion damages that now seems likely. Development of shorter season varieties would extend the northern limits of conservation tillage; seeds resistant to diseases fostered by moisture would permit spread of the technology to less well-drained soils; and development of new herbicides effective against certain weeds, especially perennials, also would extend its reach. Research on the long-term, more subtle effects of herbicides on the environment should also be a key part of the research strategy. (See also W88-07820) (Lantz-PTT)
W88-07842

ANNUAL REPORT: 1983.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6E.
W88-07847

REVIEW OF PENNSYLVANIA'S COMPREHENSIVE WATER QUALITY MANAGEMENT PLAN AND MARYLAND'S SECTION 208: WATER QUALITY MANAGEMENT PLAN FOR INTERSTATE STREAMS,
Susquehanna River Basin Commission, Harrisburg, PA.
C. Takita.
Publication No. 88. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. March 1984. 20 p, 4 fig, 7 tab.

Descriptors: *Pennsylvania, *Water quality management, *Management planning, *Maryland, *Evaluations, *Interstate rivers, Water quality control, Urban runoff, Construction, Economic aspects, Waste disposal, Fertilizers, Organic wastes, Agricultural practices, Nutrients, Bacteria, Regulations, Agricultural runoff, Nonpoint pollution sources, Septic tanks, Agricultural chemicals, Pollutants, Institutions, Enforcement, Runoff.

The Susquehanna River Basin Commission staff reviewed the Water Quality Management and Section 208 Plans for Pennsylvania and Maryland to assure compatability of the respective plans within interstate watersheds. The point source and nonpoint source management recommendations were found to be compatible. Stream use classifications for upstream and downstream segments were also found to be compatible. A summary of the land uses, water quality and point source management recommendations for the Deer Creek, Muddy Creek, Broad Creek, Michael Run, Conowingo Creek and Octoraro Creek Watersheds are provided, including: (1) The most serious nonpoint water quality problems in the area result from agricultural runoff, malfunctioning on-lot systems, residential construction, urban runoff and related activities. Lack of funds to implement management programs is the single most critical problem; (2) Over half of the area's population is and will continue to rely on on-lot disposal systems. The design, operation and maintenance of these systems are reported to be major causes for their failures; (3) Improper application of fertilizers and chemicals, organic wastes and poor farming practices are the causes of problems in the study area. Agricultural runoff contains

sediment loads which are considerably higher than point sources, bacteria, organic material, nutrients (nitrogen and phosphorus), pesticides and other chemicals. Concentrations of pollutants in runoff depend on topography, soil type, land use and rainfall patterns; (4) Although a relatively minor portion of the study area is urbanized, urban runoff is a potential concern, and additional data collection and evaluation are recommended; and (5) Available information indicate that construction site runoff and silviculture activity are not causing any major water quality problems in the area. Existing laws and regulations should be sufficient to prevent or correct any potential future water quality problems if adequately enforced. (Lantz-PTT)
W88-07848

ECOSYSTEM SCIENCE FOR THE GREAT LAKES: PERSPECTIVES ON DEGRADATIVE AND REHABILITATIVE TRANSFORMATIONS,
Department of Zoology, University of Toronto, Toronto, Ontario M5S 1A1, Canada.
R. J. Steedman, and H. A. Regier.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, Suppl. 2, p 95-103, 1987. 1 fig, 78 ref.

Descriptors: *Lake fisheries, *Aquatic ecosystems, *Lake restoration, *Ecosystem management, *Model studies, Great Lakes, Management planning, Models, Catchment areas.

Conventional approaches to ecological management presuppose the preeminence of normal natural processes in quasi-equilibrium state, in the presence of one or a few cultural stresses of light to moderate intensities. They also presuppose that the abiotic and biotic structural form of the ecosystem is relatively unaffected. In some parts of the Great Lakes, normal natural ecosystem processes have been overwhelmed by numerous intense cultural factors. Rehabilitation of such areas requires information and understanding of a type that is not central to conventional fisheries biology. The authors review and extend existing scientific approaches that contribute to an effective and relevant 'ecosystem science,' according to the criteria that they (1) incorporate spatial and structural models appropriate to an ecosystem perspective of the Great Lakes basin, (2) incorporate functional attributes actually observed in stressed and culturally degraded aquatic ecosystems, and (3) provide information directly relevant to effective, informal, broadly based mechanisms of ecosystem rehabilitation and husbandry. (Author's abstract)
W88-07945

GRID REFINEMENT APPROACH TO FLOW AND TRANSPORT MODELING OF A PROPOSED GROUNDWATER CORRECTIVE ACTION AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-07956

EFFECTIVENESS OF OIL DISPERSANTS LABORATORY EXPERIMENTS,
Institutt for Kontinentalsokkelundersoekelser, Trondheim (Norway).
H. Nes.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-752484. Price codes: A04 in paper copy, A01 in microfiche. October 1984. 51 p, 12 fig, 19 tab, 19 ref. PFO-PROSJEKT NR. 1410.

Descriptors: *Oil slicks, *Cleanup operations, *Dispersants, *Oil, Performance evaluation, Chemical properties, Norway, Emulsions, Temperature, Oil characterization.

The tests discussed in this paper attempted to study the effectiveness of different oil dispersants as applied to different oil qualities and at temperatures relevant to Norwegian conditions. The effectiveness tests used were the Mackay method and a revised version of the WSL-test (WSL/IVL test). The experiments were performed at 13 C, 6 C and at 1.5-3 C. A total of 13 concentrated dispersants were tested in this and an earlier project. The oils covered were Ekofisk crude, bunker fuel IF-30, Statfjord crude and weathered, emulsified Statfjord. The dispersants classified as highly effective from the 13 C-experiments were tested at 6C on the same oil qualities. Dispersants BP 1100 WD and Corexit 9527 showed the best performance toward Ekofisk crude oil, while the three others showed medium to high effectiveness while the three other dispersants tested (Dasic Slickgone LTE, Dispolene 34S/36S, Finasol OSR 5) showed medium to high effectiveness. A similar temperature effect was seen with IF-30, but at the highest D:O ratio 1:20, Dispolene 34S and Finasol OSR 5 showed a remarkably high effectiveness, causing complete dispersion of the oil. A further decrease in amount of Ekofisk crude oil dispersed was observed in experiment undertaken at 1.5-3 C. At this temperature, the viscosity of the IF-30 was too high to undergo dispersion in the Mackay apparatus. For experiments at 13C with the Statfjord oils, at the lowest D:O ratio of 1:100, the amount of oil in dispersion after 10 min of mixing was 76% for the crude oil, 6% for the weathered oil and 25% for the emulsified oil. An increasing D:O ratio was able to compensate for the reduced effectiveness for the weathered oil, but less so for the emulsified oil. A good correlation between results from the two tests with one oil quality does not guarantee a similar good correlation when another oil quality is tested. (Friedmann-PTT)
W88-07958

DOE HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM, ANNUAL REPORT: FY 1986,
Oak Ridge National Lab., TN. HAZWRAP Support Contractor Office.
For primary bibliographic entry see Field 5E.
W88-07971

SUPERCRITICAL WATER OXIDATION OF HAZARDOUS CHEMICAL WASTE,
Los Alamos National Lab., NM. Earth and Space Sciences Div.
For primary bibliographic entry see Field 5D.
W88-07973

RISK ASSESSMENT OF HAZARDOUS WASTES,
Sandia National Labs., Albuquerque, NM. Waste Management Systems Div. 6431.
For primary bibliographic entry see Field 5E.
W88-07974

HAZARDOUS PROCESS MATERIAL SUBSTITUTION,
Idaho National Engineering Lab., Idaho Falls.
D. R. Evans, D. D. Nishimoto, and R. D. Sanders.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 137-152, 3 tab, 5 ref.

Descriptors: *Chemical wastes, *Hazardous wastes, *Wastewater treatment, *Waste disposal, Heavy metals, Mercury, Cadmium, Chemical treatment, Lead, Incineration, Acids.

In recent years, growing attention has been focused on the generation and subsequent disposition of hazardous waste (HW) and radioactive mixed waste (RMW). Certain of the November 1984 Amendments to the Resource Conservation and Recovery Act emphasized reduction of the amount of waste generated, as opposed to its treatment and disposal, which led to establishment of the Hazardous Process Material Substitution project. In an 8-month study conducted during FY 1986, in which material substitutions, and to a lesser extent process modifications were evaluated as means to minimize HW and RMW generation. Preliminary conclusions include: (1) Little potential for hazard reduction by material substitution was found for waste corrosive acids, mercury catalyst, and combustible waste; (2) Reduction of the hazards associated with mercury in the process equipment waste can be accomplished by substituting electrolytic dissolution for the mercury-catalyzed dissolution treatment process or by treatment (e.g., fractionation) of the waste to remove mercury; (3) Although inappropriate for shielding water applications, phosphate-based corrosion inhibitors are suitable nonhazardous substitutes for those based on potassium chromate in applications such as process heating and/or cooling water; (4) Generation of lead shielding waste can be significantly reduced by eliminating unnecessary contamination, reusing slightly contaminated lead, recycling the contaminated lead that cannot be reused, and substituting steel or stainless steel shielding for lead shielding; (5) The use of cadmium for criticality control in fuel reprocessing operations could be reduced or eliminated by substituting boron enriched in 10-B; (6) The RMW generated from incinerator operations can be rendered less hazardous only be needless restrictions on the combustible waste that the facility is designed to handle. The incinerator ash RMW, containing heavy metals, is an unavoidable consequence of normal operations; and (7) Further study is required before material and/or method substitutions can be made for laboratory wastes. (See also W88-07971) (Lantz-PTT)
W88-07975

MANUAL FOR PREVENTING SPILLS OF HAZARDOUS SUBSTANCES AT FIXED FACILITIES,
Environmental Monitoring and Services, Inc., Newbury Park, CA.
W. Unterberg, R. W. Melvold, K. S. Roos, and P. A. Scofield.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-232815. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/600/2-87/068, August 1987. 186 p, 5 tab, 11 ref. append. EPA Contract No. 68-03-3014.

Descriptors: *Hazardous wastes, *Wastewater facilities, *Water pollution prevention, Waste storage, Water pollution control, Spills, Containment, Monitoring.

The purpose of the manual is to provide guidance to prevent spills of hazardous substances in fixed facilities that produce substances from raw or starter materials, store the substances, or transfer the substances to and from transportation terminals. The emphasis is on smaller-sized chemical manufacturing facilities. The manual consists of seven sections and an Appendix: (1) Introduction; (2) Manual of Practice; (3) Hazardous Substances and Their Characteristics; (4) Fixed Facilities; (5) Facility Spill Prevention Practices; (6) Preventive Engineering Practices; and (7) Bibliography. Section 1 contains the purpose and an overview of the manual. Section 2, the manual proper, deals with the preparation of a Facility Spill Prevention Master Plan and makes use of Sections 3, 4, 5, and 6. Section 3 contains a listing of all hazardous substances under consideration, with their physical behavior on release to air, water and ground, and their specific hazards. Section 4 lists the fixed facility equipment elements that would interact with hazardous substances. Section 5 lists the various facility spill prevention practices, including organization, risk identification, material compatibility, preventive maintenance, good housekeeping, security and training. Section 6 details the preventive engineering practices such as monitoring and secondary containment of storage vessels, fire protection systems, alarm systems, valving and venting, drainage control, waste treatment, etc. Section 7 lists the sources used in preparing the manual. The appendix contains descriptions of fixed facility chemical processing equipment components, from which a checklist of equipment items interacting with hazardous substances can be derived for use in preparing a Spill Prevention Plan. (Author's abstract)
W88-07980

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

SCHEMATIC MODELS FOR DISTRIBUTION SYSTEMS DESIGN. I: COMBINATION CONCEPT,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 5F.
W88-07042

SCHEMATIC MODELS FOR DISTRIBUTION SYSTEMS DESIGN. II: CONTINUUM APPROACH,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 5F.
W88-07043

PLANNING MODEL FOR OPTIMAL CONTROL OF SALTWATER INTRUSION,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 4B.
W88-07044

METROPOLITAN WATER MARKET DEVELOPMENT: SEATTLE, WASHINGTON, 1887-1987,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-07045

ANALYSES OF RESERVOIR STORAGE REALLOCATIONS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-07109

CAD COMPARISONS FOR WASTEWATER TREATMENT FACILITIES,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-07143

AGRICULTURAL WATER MODELING AND ECONOMIC INFORMATION NEEDS UNDER THE MODEL WATER CODE,
Food and Resource Economics Department, University of Florida, G-099 McCarty Hall, Gainesville, Florida 32611.
For primary bibliographic entry see Field 6E.
W88-07282

PROJECTION OF URBANIZATION EFFECTS ON RUNOFF USING CLARK INSTANTANEOUS UNIT HYDROGRAPH PARAMETERS,
Louisville Univ., KY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W88-07284

PLANNING OF URBAN BEST MANAGEMENT PRACTICES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. Y. Kuo, K. A. Cave, and G. V. Loganathan.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 125-132, February 1988. 2 fig, 5 tab, 8 ref.

Descriptors: *Best management practices, *Hydrographs, *Flood hydrographs, *Storm runoff, *Cost analysis, *Management planning, *Computer programs, *Personal computers, Algorithms, Washouts, Pollutographs, Sensitivity analysis, Detention reservoirs.

A user friendly computer program has been developed for application in personal computers for preliminary design, evaluation, and cost effectiveness analysis of various best management practice (BMP) measures to control stormwater quantity and quality. The algorithms utilize the Soil Conservation Service TR-55 method for calculating runoff hydrographs for a single storm event and a first order pollutant washoff equation to generate pollutographs. Sensitivity analyses bases on different policy scenarios is performed on a hypothetical watershed for the purpose of illustration. Three types of BMP measures, namely detention ponds (dry, wet, and extended wet ponds), infiltration trenches, and porous pavements are considered. It is found that the extended wet ponds have the best cost effective performance of the measures evaluated. (Author's abstract)
W88-07285

INFORMATION, THE DECISION FORUM, AND THIRD-PARTY EFFECTS IN WATER TRANSFERS,
New Mexico Univ., Albuquerque. Dept. of Economics.
S. C. Nunn.
Water Resources Research WRERAO, Vol. 24, No. 4, p 473-480, April 1988. 22 ref.

Descriptors: *Information exchange, *Economic aspects, *Water law, *Ecological effects, *Decision making *Institutional constraints, Water transfer, Irrigation, Rural areas, Municipal water, Industrial water.

Transfers of water from irrigation to municipal and industrial uses are seen as a low-cost approach to the water supply problems of western cities. Rural areas of origin protest that market transfers ignore indirect economic, political, social, fiscal, and environmental effects of changes in water use. The capacity of five different water transfer institutions: the market, courts, legislature, special purpose districts, and administrative agencies, to develop and weigh information about indirect and nonuser impacts was analyzed. All five forums have biases regarding the type of information used. Markets process information on direct economic costs and benefits well but ignore third-party costs; legislative bodies are sensitive to information about indirect and nonuser impacts but distort information on direct benefits and costs; neither the judiciary nor the water agency is likely to consider community and social impacts of water transfers. Special districts could consider both direct and indirect values but are often controlled by a leadership elite, pursuing narrow goals with minimum membership participation. The appropriate forum for decision making depends upon our priorities among values and on the values that are at stake in particular issues. (Author's abstract)
W88-07437

HYDROPOWER PLANNING IN DEVELOPING COUNTRIES,
R. F. Kilmartin.
Journal of Energy Engineering JFEED9, Vol. 114, No. 1, p 1-25, April 1988. 8 fig, 1 tab, 13 ref.

Descriptors: *Computer models, *Hydroelectric Power, *Project planning, *Planning, *Developing countries, Utilities, Mathematical models, Electric powerplants, Long-term planning.

The 1960s and 1970s saw the development in the U.S. and Europe of a number of useful mathematical planning tools for electric power systems. Utilization of these tools in practical application, however, appears more significant in some of the developing countries than in the industrialized countries where they originated. It is not uncommon to find electric power utilities in the third world countries that are using and indeed developing state of the art planning techniques in long-range generation planning. This is particularly so for systems with large amounts of existing and/or potential hydroelectric power. Despite the approximations that are necessary, these techniques furnish planners and decision makers with valuable insights on the range of possible long-term consequences of near-term decisions. Computer models that have been found useful in long-range planning in nations with high hydro potential include EVAL (a group of site selection evaluation programs), MGI (a linear programming optimization model), IPA (a hydrothermal system simulation model), and WASP (a system planning package). No single model is sufficient for development of some part of the task efficiently but alternating interactive cross-checks are necessary. (Freidmann-PTT)
W88-07504

CHEMUNG SUBBASIN: LOW FLOW MANAGEMENT FRAMEWORK PLAN,
Susquehanna River Basin Commission, Harrisburg, PA.
D. W. Heicher, R. E. Edwards, and G. H. Hirschel.
Publication No. 109. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. April 1987. 200 p, 12 fig, 46 tab, 43 ref, 6 append.

Descriptors: *Management planning, *Water supply, *Instream flow, *Pennsylvania, *New York, *Chemung River, Drainage systems, Surface-groundwater relations, Prediction, Water demand, Low flow, Water management.

The Chemung Subbasin is located in north central Pennsylvania and the southern tier counties of central New York State. The subbasin covers a drainage area of 2,596 sq mi, with about 67% of the area lying in New York and 33% in Pennsylvania. The purpose of this framework is to provide for the coordinated management of water supplies in the Chemung Subbasin. Because the drainage system is interstate, the geographic limits of most previous planning efforts have been at least partly dictated by political boundaries. Surface and groundwater availability are examined, with particular emphasis on low flows, as well as their frequency and duration. Water demand and historic low flows are analyzed to define existing and future water supply problems within specific geographic areas. The 7-day 10-year low flow value (Q7-10) is used as a target value to identify projected water deficiencies during low flow events. Potential management actions are identified for further consideration and feasibility analysis. Data gaps are identified and discussed. This framework plan is dynamic, and may be modified as water supply needs change. This plan is the first in a series of planning efforts to be performed for major subbasins of the Susquehanna River Basin. Ultimately, subbasin management plans will be integrated to assist in managing for periods of low flows throughout the Susquehanna River Basin. (Lantz-PTT)
W88-07735

STREAM SAMPLING FOR WASTE LOAD ALLOCATION APPLICATIONS,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5E.
W88-07753

EXECUTIVE SUMMARY OF LONG-RANGE ENVIRONMENTAL MANAGEMENT PLANS, FY 1987-1993,
Martin Marietta Energy Systems, Environmental and Safety Activities Organization.
M. E. Mitchell, C. G. Jones, L. W. Long, L. J. Mezga, and T. P. A. Perry.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-100967. Price codes: A03 in paper copy, A01 in microfiche. Report No. ES/ESH-2, June 1987. 28 p, 4 fig, 13 tab, 7 ref. DOE Contract No. DE-AC05-840R21400.

Descriptors: *Management planning, *Environmental policy, *Water pollution prevention, *Environmental protection, Air pollution, Solid wastes, Waste management, Monitoring, Costs.

In recent years, the Energy Systems Environmental Protection Program has become an extremely complex activity requiring careful management and considerable resources. With the continuing increase in understanding of environmental needs (to remedy problems resulting from past operations, as well as those of present and future operations) there has been a corresponding increase in

the need for more comprehensive planning to ensure adequate and consistent resolution of problems, as well as optimization of resources. In response to this need, a strong, centralized planning function has been established. The Energy Systems Planning Activity is comprised of six separate subactivities which are integrated into a single comprehensive plan. These six subactivities include: (1) Comprehensive environmental management (the administrative function required to formulate and implement the plan); (2) Air pollution control; (3) Water pollution control; (4) Solid waste management; (5) Remedial action; and (6) Environmental monitoring. Research and development needed to implement each of these separate activities is included where appropriate. For each sub-activity, a set of objectives and strategies for meeting the objectives was formulated by a task team comprised of representatives from each installation. Each task team is under the oversight of a Central Environmental and Safety Activities Manager who also is responsible for obtaining understanding and agreement with DOE for his/her respective strategy. The various sections of the report provide (1) a summary of cost estimates for each of the next seven years, as well as for the long-term, and (2) a brief overview of the strategies to be followed in meeting the objectives for each of the six functional areas previously mentioned. (Lantz-PTT)
W88-07761

CAMAS CREEK (MEYERS COVE) - ANADROMOUS SPECIES HABITAT IMPROVEMENT PLAN,
For primary bibliographic entry see Field 2H.
W88-07770

POLICY DEVELOPMENT AND THE REGIONAL ECONOMICS OF IMPLEMENTING NPS CONTROLS,
Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.
For primary bibliographic entry see Field 5G.
W88-07840

NATIONAL MODELING AND POLICY ANALYSIS OF AGRICULTURAL NONPOINT SOURCE CONTROL OPTIONS,
Resources for the Future, Washington, DC. Environmental Policy Evaluation Program.
For primary bibliographic entry see Field 5G.
W88-07841

TRENDS IN AGRICULTURE AND POSSIBLE ENVIRONMENTAL FUTURES,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 5G.
W88-07842

EROSION-PRODUCTIVITY ECONOMICS MODEL: A USER'S GUIDE,
Economic Research Service, Temple, TX. Resources and Technology Div.
For primary bibliographic entry see Field 2J.
W88-07967

6B. Evaluation Process

ALLOCATION OF AQUIFER RESOURCES IN SCOTLAND,
British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, Scotland.
N. S. Robins.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 1, p 59-62, 1987. 2 fig, 4 ref.

Descriptors: *Aquifers, *Groundwater potential, *Catchments, *Water supply, *Waste disposal, Planning, Aquifer characteristics, Waste storage, Legislation, Surface water availability.

The traditional role of aquifers for groundwater supply may not be appropriate in some areas of Scotland where high rainfall, low evapotranspiration, and abundant upland catchments and storage areas yield more than adequate surface water supplies. Some groundwater will always be required to satisfy specific needs but much aquifer potential will remain untapped. It is suggested that some of this potential could usefully be allocated to the disposal of wastes including oiled beach material, or the storage of heat or fluids, any of which could contaminate the aquifer. Care will be required to ensure that surface waters and other amenities are not put at risk. Resolution of conflicts between water supply and waste disposal usage of an aquifer requires guidelines; suggestions are made for their formulation and the need for legislative and planning controls is outlined. (Author's abstract)
W88-06963

GROUNDWATER CONTAMINATION BENEFIT-COST ANALYSIS METHODOLOGY,
Jones and Henry Engineers Ltd., Toledo, OH.
For primary bibliographic entry see Field 5G.
W88-07046

JOINT RESERVOIR AND AQUEDUCT DESIGN AND OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5F.
W88-07047

ROLE, OPERATION AND POSSIBLE IMPACTS OF SUPPORT COMMUNICATION ON WATER RESOURCES DEVELOPMENT,
Nigerian Inst. of Social and Economic Research (NISER), Ibadan, Nigeria.
F. Olokesusi.
Environmental Education and Information, Vol. 6, No. 1, p 20-34, January-March 1987. 3 fig, 2 tab, 23 ref.

Descriptors: *Water resources development, *Public participation, *Support communication, *Management planning, *Developing countries, Ecological effects, Information exchange, Environmental impact statement, Monitoring.

This paper seeks to explore the following: (1) to identify the need for support communication in water development projects and (2), to describe how the support communication process could be planned and implemented, as a component of the larger development planning and implementation processes in developing countries in general, and with a view to enhancing environmental quality in particular. The paper focuses primarily on water projects in the rural areas of developing nations. In many developing nations, governments and aid agencies can not wish informed public opinion into existence overnight. Quite some painstaking and patient work will have to be done to wipe out the pyramid of ignorance, inertia and complacency. Also, support communication should be a component of the Environment Impact Assessment and Review processes in these countries, and the earlier they all make EIA mandatory, the better. Consequent upon the vital roles which water plays in human development, there is the need to integrate water resources programs with local and regional development processes. This would enable adequate consideration of the major impacts and necessary mitigation measures. It would also encourage the use of regular monitoring, particularly of ecological and socio-economic indicators as development evaluation tools. National governments should improve public information about sanitation, environmentally desirable and sustainable development. (Alexander-PTT)
W88-07049

MANAGEMENT OF THE RIVER RHINE,
C. Van Der Veen.
European Water and Sewage, Vol. 91, No. 1097, p 286-288, July 1987. 7 fig.

Descriptors: *Water resources development, *Aquatic habitats, *Water law, *River Rhine, *River management, *Catchment areas, Drinking water, Recreation, Effluents.

In the list of world rivers the Rhine occupies 81st place, in terms of length, catchment area, and discharge, preceded in Europe by the Volga and the Danube. In Western Europe the Rhine is of major importance. The Rhine catchment area has a high density of population; about 40 million people live in an area of 160,000 sq km (250 inhabitants per sq km). The Rhine is an international river, which is being used for many different purposes such as drinking water supply, navigation, discharge of wastewater, fishing and recreation. Above all it is an important aquatic ecosystem and part of the environment and landscape. A Rhine Navigation Committee was installed with executive powers and given the task of acting as a court of appeal in the case of conflicts of river management. The Treaty of Mannheim worked extremely well. The weakness of this Committee shows in the extremely slow way results were obtained. A treaty against chemical pollution was signed and ratified in 1976 which prohibited the discharge of persistent toxic substances and stipulates that pollution by a number of other harmful substances should be reduced. This was an achievement. However in reality very slow progress has been made. Until now specific guidelines have been laid down for not more than about five persistent toxic substances. (Alexander-PTT)
W88-07065

EVALUATION OF COSTS ASSOCIATED WITH REGIONAL, ENVIRONMENTAL IMPACT IN CHESAPEAKE BAY,
West Virginia University, Morgantown, WV.
R. Walker, and K. Rex-Lopatto.
Journal of Environmental Systems, Vol. 17, No. 1, p 15-31, 1987. 2 fig, 23 ref, append.

Descriptors: *Cost-benefit analysis, *Estuarine fisheries, *Environmental effects, *Chesapeake Bay, Fish populations, Striped bass, Commercial fishing, Habitat losses, Sport fishing, Environmental quality, Environmental policy, Simulation analysis, Model studies, Aquatic habitats, Submerged plants, Aquatic plants, Carrying capacity, Profit.

Environmental impact in Chesapeake Bay is examined, particularly as it relates to the health and maintenance of striped bass populations valuable to both sports and commercial fisheries. Declining environmental quality affects both producers and consumers, and forces environmental planners to make decisions about acceptable levels of pollution; this is not a trivial task, for the relationships between the environment, production, and consumption can be exceedingly complex. A dynamic simulation model is developed using optimal control theory to calculate accumulating opportunity costs of fish population decline caused by pollution in the bay. The model is then applied to the actual situation using data on striped bass populations and rates of habitat loss resulting from disappearing submerged aquatic vegetation. Simulations begin in 1974, a year for which a reliable estimate of striped bass carrying capacity exists. The model is set up to provide information that can be used in benefit-cost analysis, and the impact cost is calculated over time periods during which environmental conditions are modeled to change. If harvesting begins immediately, stocks are low and profits are small; if harvesting is deferred to later dates, greater profits can be obtained. If striped bass is valued at $.57/pound the opportunity cost of pollution determined by this model is approximately $12,570,000. (Shidler-PTT)
W88-07224

PRIORITIZING WATER MANAGEMENT PROJECTS IN SOUTHEAST ASIA: AN EXPERIMENTAL METHODOLOGY,
P. F. M. McLoughlin.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 189-200, February 1988. 2 tab, 60 ref.

Descriptors: *Project planning, *Economic aspects, *Water use, *Water demand, *Asia, *Cost-benefit analysis, Assessments, Investment, Data collections.

Southeast Asian nations with extensive water management systems have numerous candidate and ongoing programs and projects. They cannot pos-

sibly all be funded and implemented simultaneously in any serious way. This paper suggests a methodology by which assessment criteria can be constructed that conforms to any given national information base and development needs. Criteria can be weighted one against the other in their relative importance. For each criterion a ranking scale puts the 'best' (most, highest) at one end and the 'worst' (least, lowest) at the other. Each candidate project is then subjected to these consistent assessment methods for a weighted 'score.' Key criteria normally have surrogate measures depending on information available. Criteria are of three sorts: sheer volume, e.g., of a specific use, a benefit; ratios and relations, e.g., A as percent of B; and other more subjective criteria, e.g., regional or income distribution impacts. The basic criteria include, for example, time to full benefits (minimize), operational express, maintenance, and repairs as percent of investment (minimize), and permanent rural jobs created (maximize). (Author's abstract)
W88-07293

USING COMPUTERS FOR WATER DISTRIBUTION MANAGEMENT,
Boston Water and Sewer Commission, Boston, Massachusetts.
For primary bibliographic entry see Field 5F.
W88-07481

MICROCOMPUTERS CAN AID IN SANITARY SEWER SYSTEM ANALYSIS AND DESIGN,
James Miertschin and Associates, Inc., Austin, Texas.
For primary bibliographic entry see Field 5D.
W88-07482

INFRASTRUCTURE INTERROGATION AND SYSTEMATIC REHABILITATION ALTERNATIVES PROGRAM,
City of West University Place, Texas.
R. E. Simpson.
Southwest and Texas Water Works Journal STWJDV, Vol. 69, No. 3, p 8-9, June, 1987.

Descriptors: *Maintenance, *Alternative planning, *Infiltration, *Inspection, *Data acquisition, *Utilities, Planning, Monitoring, Computers, Automation, Data acquisition, Maps, Flumes, Weirs, Cost analysis, Flow, Wastewater treatment, Surveys.

The systematic interrogation approach to devising a cost-effective rehabilitation alternative program is discussed. The program should consist of the following elements: (1) Physical survey, including system map, system condition data, groundwater table investigation, above-ground inspection, and manhole inspection; (2) testing, including system flow monitoring, smoke and dye flooding, and internal TV investigation; (3) formulating a computerized data base; (4) analyzing results, including setting system priorities and reviewing of alternatives; and (5) master planning, including systematic rehabilitation and systematic reconstruction. It is concluded that the removal of inflow and infiltration, by whatever method used, is cost-effective in the long term. Serious consideration should be given to the use of computers in the decision-making process. (Doria-PTT)
W88-07652

CUSTOMER SERVICE SURVEY,
Little Rock Municipal Water Works, AR.
G. Pittman, and K. Seib.
Southwest and Texas Water Works Journal STWJDV, Vol. 69, No. 5, p 4-7, August, 1987. 6 fig.

Descriptors: *Surveys, *Operating policy, *Data collections, *Utilities, *Water treatment facilities, *Water demand, Economic aspects, Prices, Pricing, Water use, Scheduling, Payment.

A customer service survey was sent to 43 cities within the Southwest and Texas sections of the American Water Works Association to provide comparison data for considering changes to existing policies. Results are discussed; topics include organization, staffing, water service requirements, rates, service charges, billing, hours of service, discontinuation of service, and other services. It is concluded that, since customers are the reason for a water utility's existence, they deserve more attention and concern than they have previously been given. Existing policies and practices should be reviewed periodically in terms of their effects on customers. (Doria-PTT)
W88-07653

BEST MANAGEMENT PRACTICE IMPLEMENTATION ECONOMICS AND FARMER DECISION MAKING,
Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W88-07839

REVIEW OF PENNSYLVANIA'S COMPREHENSIVE WATER QUALITY MANAGEMENT PLAN AND MARYLAND'S SECTION 208: WATER QUALITY MANAGEMENT PLAN FOR INTERSTATE STREAMS,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5G.
W88-07848

MODEL APPROACH TO ACID RAIN,
Laboratory for Waste Materials and Emissions, the National Institute for Public Health and Environmental Protection, Bilthoven, the Netherlands.
L. Hordijk.
Environment ENTVAR, Vol. 30, No. 2, p 16-20, 40-42, March 1988. 6 fig, 1 tab, 14 ref.

Descriptors: *Acid rain, *Sulfur dioxide, *Path of pollutants, *Mathematical models, *Air pollution effects, *Water pollution effects, *Ecological effects, *Policy making, *Information exchange, Lake acidification, Soil acidification, Europe, Regional Acidification Information and Simulation model.

To make intelligent and constructive policies for the purpose of controlling acid deposition in Europe, governments and industry not only need pertinent and timely scientific information on the acidification problem, but also need the information structured in a form that can be used for decision making to create a policy based on available scientific evidence and credible judgments about the probability of future events. An integrated model has been developed to synthesize the vast amount of unstructured information about acidification and to deal with the many crucial uncertainties associated with pollution emissions and their environmental effects. In close collaboration with the United Nations Economic Commission for Europe (ECE) and many European and North American policy advisors, the International Institute for Applied Systems Analysis (IIASA) in Austria is developing the model in an attempt to link the sources of emissions with the transboundary transport of pollutants and the effects on soils, lakes, forests, and groundwater and as a tool to assist decision makers. The RAINS (Regional Acidification Information and Simulation) model can be used to analyze the effects of policy actions regarding use of alternative energies and various technologies to reduce emissions. In constructing the model, existing models have been used as much as possible and linked in a single framework. Scientists from many countries have served in the model's review process. The model is discussed here along with its current application to sulfur dioxide emissions, its use in submodeling soil and lake acidification, as well as the uncertainties associated with its use. (Brock-PTT)
W88-07943

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

CONTRACTUAL OPERATION AND MAINTENANCE SERVICES FOR EFFICIENT AND COST EFFECTIVE MANAGEMENT OF UTILITY SERVICES AND INDUSTRIAL PLANTS,
For primary bibliographic entry see Field 5F.
W88-07059

ECONOMIC FEASIBILITY OF THE REVERSE OSMOSIS PROCESS FOR SEAWATER DESALINATION,
Leitner and Associates, Inc., 815 Shadow Lawn Drive, Elm Grove, WI 53122.
For primary bibliographic entry see Field 3A.
W88-07237

VALUING IRRIGATION WATER: A SIMULATION/MATHEMATICAL PROGRAMMING APPROACH,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
D. J. Bernardo, N. K. Whittlesey, K. E. Saxton, and D. L. Bassett.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 149-157, February 1988. 4 fig, 4 tab, 15 ref.

Descriptors: *Irrigation, *Irrigation efficiency, *Simulation, *Value, *Economic evaluation, *Pricing, Irrigation water, Water stress, Water allocation, Policy making, Costs, Marginal costs, Mathematical models, Optimization.

A two-stage simulation/mathematical programming model was developed to derive irrigation water values that reflect efficient response to reduced water supplies. The failure of many previous water valuation studies to represent the dynamic dimension of irrigation was shown to result in overestimation of derived water values. Water values are also shown to be dramatically influenced by both application system characteristics, and the relative costs of irrigation inputs. Finally, the marginal value of irrigation water was shown to vary considerably over the irrigation season, reaching its maximum when atmospheric demand is highest and crops are most susceptible to water stress. Results presented should be of interest to policy makers investigating the viability of alternative water reallocation mechanisms. (Author's abstract)
W88-07288

DEALING FOR WATER IN THE WEST: WATER RIGHTS AS COMMODITIES,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W88-07377

DOMINANCE OF THE INTERNAL RATE OF RETURN AS A PLANNING CRITERION AND THE TREATMENT OF O & M COSTS IN FEASIBILITY STUDIES,
Overseas Development Inst., London (England).
M. Tiffen.
Water Resources Journal, No. 154, p 20-25, September 1987. 1 fig, 2 tab, 13 ref.

Descriptors: *Cost analysis, *Operating costs, *Maintenance costs, *Water costs, *Rate of return, *Feasibility studies, Developing countries, Economic aspects, Social aspects, Institutional constraints, Cost-benefit analysis, Irrigation.

Use of the internal rate of return in planning irrigation projects has several defects: (1) bias against durability and the assumption that capital is the scarce factor; (2) bias against slow startup (phased implemeatation may, in fact, be more advantageous); (3) under-emphasis on risk of different outcomes; (4) bias against flexibility; (5) ease with which cost-benefit analysis can be manipulated to increase the rate of return to conform with the planner's opinions. A history of poor outcome of irrigation projects suggests that the concept of project sustainability should be of more concern. Analysis of factors influencing project success points to interest and cooperation from the project beneficiaries, sufficient farm incomes to utilize the project, satisfactory water prices to guarantee the desired cost recovery, and efficiency of delivery. Feasibility studies for water projects in developing countries cannot follow guidelines for studies in developed countries. A greater concern for farm

incomes and for resources for operations and maintenance would influence design. It could affect size of the service area, length of the main canal, choice of technology, degree of farmer involvement in maintenance, phasing of development, choice of more durable equipment vs. cheaper ones that need replacement or repair, and acceptance of a higher than normal risk that the optimum water supply may be unavailable for a second or third crop. It is suggested that the economic internal rate of return not be abandoned. The project feasibility should start at the farm income level and be tested by seeing if resources for operation and maintenance are sufficient and by checking if the rate of return is 8% or greater. (Cassar-PTT)
W88-07555

WATER METER TESTING TO RAISE REVENUES: AN ABSOLUTE NECESSITY IN A DIFFICULT ECONOMY,
The Ford Meter Box Company, Wabash, Indiana.
For primary bibliographic entry see Field 7B.
W88-07651

POLICY DEVELOPMENT AND THE REGIONAL ECONOMICS OF IMPLEMENTING NPS CONTROLS,
Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.
For primary bibliographic entry see Field 5G.
W88-07840

CURACAO: DRINKING WATER SUPPLY,
Water and Power Corporation, P.O. Box 2097, Curacao, Netherlands Antilles.
For primary bibliographic entry see Field 3A.
W88-07881

6D. Water Demand

GROUNDWATER RESOURCES AND DEVELOPMENT IN CHINA,
Ministry of Geology and Mineral Resources, Beijing, China.
For primary bibliographic entry see Field 2F.
W88-06879

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS,
For primary bibliographic entry see Field 3F.
W88-07251

IDENTIFICATION OF MONTHLY TRENDS IN URBAN WATER USE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
E. W. Whitlatch, and M. J. Martin.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 169-174, February 1988. 3 fig, 5 tab, 4 ref.

Descriptors: *Water supply, *Monthly distribution, *Water use, *Water demand, *Municipal water, Drinking water, Potable water, Regression analysis, Consumptive use, Columbus, Ohio.

Monthly water use for the period 1960-1984 for the Columbus, Ohio, metropolitan area is analyzed to identify differential monthly trends in growth of water use. By associating water use activities with the identified trend months, inferences may be made as to the possible underlying causes of the observed trend in overall water use. Three methods were found useful in determining monthly trends: (1) regression analysis on the monthly percentage of annual use, (2) regression analysis on the monthly water use data itself, and (3) analysis of the slope of the monthly water use regression line. Agreement between the three methods is strong, but each provides some insight not found in the others. All three should be used in drawing final conclusions. For the case study, usage in the winter months January-April has grown considerably relative to the other months, while the summer-fall months of June, August, September, and October show a relative decline. A possible explanation for the trend is aging of the distribution system, with consequent general leakage and increased water main breakage caused by freeze/thaw conditions. More research needs to be carried out linking water use activities to particular months or groups of months. (Author's abstract)
W88-07290

WATER MARKETING IN SOUTHERN CALIFORNIA,
Metropolitan Water District of Southern California, 1111 Sunset Blvd., Los Angeles, CA 90012.
M. B. Holburt, R. W. Atwater, and T. H. Quinn.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 38-45, March 1988. 1 fig, 3 tab.

Descriptors: *Marketing, *Water supply development, *California, *Legal aspects, *Political aspects, Water exchange, Groundwater storage, Colorado River, Urban areas, Agriculture, Reservoirs, Water reuse, Water conservation.

The Metropolitan Water District of Southern California, faced with the prospect of severe water supply shortages within the next 20 years, is in the process of negotiating a series of water exchanges, groundwater storage programs, and other arrangements to help meet future demands. These programs include the use of reclaimed wastewater, groundwater banking, water conservation, and offsite stream reservoir storage. Efforts are being made to enhance future water supplies for urban areas in Southern California while meeting legal requirements and minimizing the adverse effects on agricultural users. (Author's abstract)
W88-07378

URBAN USE OF ARIZONA'S RURAL GROUNDWATER,
City of Mesa, Box 1466, Mesa, AZ 85201.
K. F. Kohlhoff.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 46-50, March 1988. 1 fig, 3 tab.

Descriptors: *Water rights, *Water supply development, *Arizona, *Water transfer, *Water law, *Municipal water, *Economic aspects, *Urbanization, *Urban planning, Rural areas, Groundwater, Potential.

Mesa, Arizona, the second-fastest-growing city in the United States, has joined other Arizona cities in buying rural groundwater rights to secure sufficient water supplies for the future. The state's 1980 Groundwater Management Act established comprehensive rules for controlling the use of this valuable underground resource, but the law has proved insufficient to address water-transfer problems stemming from the clash of urban and rural ideologies that inevitably erupts when cities go into the 'water-farming' business. Mesa's experience of working closely with rural interests to ensure that its water farming venture will be economically beneficial to both city and rural residents is discussed. (Author's abstract)
W88-07379

MITIGATING THIRD-PARTY EFFECTS,
Fairfield and Woods, One United Bank Center, Suite 2400, 1700 Lincoln St., Denver CO 80203.
For primary bibliographic entry see Field 6E.
W88-07380

PROTECTING SOCIAL VALUES IN WESTERN WATER TRANSFERS,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 6E.
W88-07381

MATCHING WATER SUPPLY TECHNOLOGY TO THE NEEDS AND RESOURCES OF DEVELOPING COUNTRIES,
Cowater International, 304-411 Roosevelt Avenue, Ottawa, Canada K2A 3X9.
M. G. McGarry.
Water Resources Journal, No. 154, p 11-19, September 1987. 5 ref.

Descriptors: *Water supply, *Institutional constraints, *Water policy, *Developing countries, Water management, Rural areas, Public health, Water supply development, Water resources development, Political aspects, Government supports, Community development.

Although many low-cost technologies are available for water supply development, their implementation is often hindered by institutional conditions. Institutions and methods established for the urban regions are inappropriate for the poor in rural regions and on the outskirts of the cities. Two answers to this problem are lowering the cost of technology and involving the users in operation and maintenance of the water system. Acceptance of tied-aid from the industrialized countries is damaging in the long run because of incompatibility between donated equipment and local needs, an unreasonably large number of different makes and models, dependence on the donor for spare parts, and expense of training maintenance technicians. Community involvement in water resources development is important. Whereas official planners assume that a population desires a safe, convenient water supply to improve public health, this is often only a low-level priority to the community. In one case, a water system was implemented because the local cricket club wished to play without having to clean the ball frequently. The importance of involving women in planning and implementation of water systems must be emphasized, since they are more interested in sanitation than most men. In Kenya a crew of women was trained to maintain the village pump. The main strategies for water resources development in the poorer regions must include the (1) technologies acceptable by the community, (2) development of a feeling of community ownership and responsibility for the project, (3) decentralization of operations. (Cassar-PTT)
W88-07554

WATER USE DATA IN THE SUSQUEHANNA BASIN, PART I: STATUS OF DATA COLLECTION.
Susquehanna River Basin Commission, Harrisburg, PA. Planning and Operations Div.
For primary bibliographic entry see Field 7C.
W88-07725

WATER DISTRIBUTION SYSTEM INFRASTRUCTURE STUDY, CITY OF NORWICH, N.Y.,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5F.
W88-07729

CHEMUNG SUBBASIN: LOW FLOW MANAGEMENT FRAMEWORK PLAN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6A.
W88-07735

WATER USE DATA IN THE SUSQUEHANNA BASIN, PART II: WATER USE INVENTORY IN NEW YORK,
Susquehanna River Basin Commission, Harrisburg, PA.
D. R. Jackson.
Publication No. 85. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. January 1984. 161 p, 3 tab, 9 ref, 2 append.

Descriptors: *Water use, *Data collections, *Susquehanna River basin, *Surveys, Data storage and retrieval, New York.

Although a number of water use inventories have been accomplished over the years and for various purposes throughout the basin, there was a perceived need to conduct a detailed inventory in the New York portion of the Susquehanna River basin.

To establish a measure of comparability of water use data with the neighboring signatory State of Pennsylvania where a current inventory of water use has been maintained over the past 12 years, a detailed inventory program was undertaken by the Susquehanna River Basin Commission (SRBC) staff for and at the request of New York. The purpose of this report is to describe the inventory process, summarize the data, and recommend future courses of action. In order to manage water resources it is necessary to know how much water is available and how much is being used. The goals of the inventory program are: (1) To obtain a detailed update of water usage in the New York portion of the Susquehanna basin; and (2) To aid in achieving the common goal of establishing and maintaining a basinwide uniform water use informational system. (Lantz-PTT)
W88-07738

ENERGY POTENTIAL OF IRISH GROUNDWATERS,
Geological Survey of Ireland, Beggars Bush, Dublin 4, Ireland.
For primary bibliographic entry see Field 4B.
W88-07912

6E. Water Law and Institutions

ROLE, OPERATION AND POSSIBLE IMPACTS OF SUPPORT COMMUNICATION ON WATER RESOURCES DEVELOPMENT,
Nigerian Inst. of Social and Economic Research (NISER), Ibadan, Nigeria.
For primary bibliographic entry see Field 6B.
W88-07049

INTERBASIN WATER TRANSFERS IN RIPARIAN STATES: A CASE STUDY OF GEORGIA,
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 87-94, February 1988. 2 fig, 13 ref.

Descriptors: *Interbasin transfers, *Riparian doctrine, *Water rights, *Water allocation, *Permits, Legal aspects, Riparian waters, Riparian rights, Water management.

Under the riparian doctrine of eastern states, transfers of water to nonriparian lands and, thus, to different river basins, are only possible if the natural flow theory has been modified to allow for reasonable use. Even this adaptation is too nebulous to provide water managers and water users with certainty regarding water transfers. To provide a more precise mechanism for allocating water, 14 eastern states have adopted some form of administrative permitting process. Of these, five states statutorily allow for interbasin transfers of water. Thus far, no states have successfully issued permits for interbasin water transfers but Georgia and South Carolina are positioned to do so. Whether the permitting process will deter court action may rest on the ability of affected parties to negotiate an equitable agreement. (Author's abstract)
W88-07281

AGRICULTURAL WATER MODELING AND ECONOMIC INFORMATION NEEDS UNDER THE MODEL WATER CODE,
Food and Resource Economics Department, University of Florida, G-099 McCarty Hall, Gainesville, Florida 32611.
G. D. Lynne.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 95-101, February 1988. 2 tab, 34 ref.

Descriptors: *Economics, *Model studies, *Model Water Code, *Permits, *Legal aspects, *Water allocation, *Prediction, Forecasting projections, Simulation, Information systems.

Economic information for efficient water allocation is difficult and costly to acquire under administrative water systems evolving under the Model Water Code. One approach to obtaining more information is to use a simulator like the Florida AGWATER model. The advantage of AGWATER is the potential for realistic prediction, because it operates at the field and day levels, using detailed information for each crop and tract. Unfortunately, such simulators are complex and require large amounts of costly input data. A better solution to the information problem may be to use markets for the marketable goods associated with water, because information is inherent in such a process. This approach will allow limited modeling and management resources to be put into using water models to generate information for the goods dependent on water that are difficult to market, like wildlife services. (Author's abstract)
W88-07282

EFFECTS OF DIVERSION ON THE NORTH AMERICAN GREAT LAKES,
Rm. 6440, Social Science Bldg., University of Wisconsin, Madison, Wisconsin 53706.
For primary bibliographic entry see Field 6F.
W88-07287

ALTERNATIVE TO WATER POLLUTION CONTROLS,
Villanova Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6F.
W88-07292

PRIORITIZING WATER MANAGEMENT PROJECTS IN SOUTHEAST ASIA: AN EXPERIMENTAL METHODOLOGY,
For primary bibliographic entry see Field 6B.
W88-07293

DEALING FOR WATER IN THE WEST: WATER RIGHTS AS COMMODITIES,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
D. B. Bush.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 30-37, March 1988. 8 ref.

Descriptors: *Water rights, *Riparian rights*, *Marketing*, *Water supply, *Economic aspects.

Because few water resources in the western portions of the United States remain undeveloped, increasing demand for new uses for water has created a need for transfers. Although today's free market for water in the West is more an ideal than a reality, privately negotiated water transfers are increasing in frequency and volume. The how and why different markets are formed, the characteristics of several types of such markets, and the types of water rights for which buyers and sellers are dealing are discussed. Examples illustrate the sales, lease, option, and negotiated arrangements for the transfer of water rights. (Author's abstract)
W88-07377

MITIGATING THIRD-PARTY EFFECTS,
Fairfield and Woods, One United Bank Center, Suite 2400, 1700 Lincoln St., Denver CO 80203.
K. B. Pratt.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 51-57, March 1988. 21 ref.

Descriptors: *Water law, *Water rights, *Municipal water, *Water transfer, *Colorado, *Legal aspects, *Economic aspects, *Irrigation water.

Water transfer proposals in the state of Colorado involve lengthy hearings in water court to determine the adverse effects on traditional users, usually irrigators of farmland, weighed against the benefits of a 'higher' use, usually municipal water supplies. Available water for the growing cities along the eastern flank of the Front Range of the Rocky Mountains is frequently located far from the cities themselves, and the potential for damage affects not only farmers but also small towns that are dependent on an agricultural economy. Minority shareholders in water entities seek to prevent immediate damage to crops as a result of a transfer and, at the same time, to retain or increase the value of their shares in the water rights for potential profitable transfer at a later date. The legal basis used in a recent decision to protect the conflicting interests of a transferor and the objectors to the transfer are examined. Many issues were resolved by compromise; others were deferred for future rulings. (Author's abstract)
W88-07380

PROTECTING SOCIAL VALUES IN WESTERN WATER TRANSFERS,
Conservation Foundation, Washington, DC.
P. C. Metzger.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 3, p 58-65, March 1988. 39 ref.

Descriptors: *Water law, *Water transfer, *Legal aspects, *Economic aspects, *Social aspects, *Irrigation water, Agriculture, Rural areas, Municipal water.

Western states are beginning to face the economic and social challenges involved in transferring water from agricultural use to municipalities and industries. Because massive water development projects are not likely to be undertaken in the future, wise water management entails providing the legal tools to permit water to be shifted to areas of greatest need at the least harm to traditional agricultural users. Coping with these transfers requires, in many instances, changes in existing prior appropriation water laws, e.g., efforts to promote more efficient use of water on farmlands should be accompanied by provisions to allow the sale of salvaged water. scenarios for protecting the social and economic interests of rural areas in the context of growing urban water demands are discussed. (Author's abstract)
W88-07381

STRETCHING THE SYSTEM: THE CHALLENGE OF GROUNDWATER PROTECTION,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 5G.
W88-07415

CLEAN WATER ACT: NPDES PERMIT STRATEGIES,
For primary bibliographic entry see Field 5G.
W88-07416

INFORMATION, THE DECISION FORUM, AND THIRD-PARTY EFFECTS IN WATER TRANSFERS,
New Mexico Univ., Albuquerque. Dept. of Economics.
For primary bibliographic entry see Field 6A.
W88-07437

MATCHING WATER SUPPLY TECHNOLOGY TO THE NEEDS AND RESOURCES OF DEVELOPING COUNTRIES,
Cowater International, 304-411 Roosevelt Avenue, Ottawa, Canada K2A 3X9.
For primary bibliographic entry see Field 6D.
W88-07554

UPCOMING REGULATIONS: HOW THEY WILL AFFECT THE WATER INDUSTRY,
Camp, Dresser and McKee, Inc., Boston, MA.
F. H. Elwell.
Southwest and Texas Water Works Journal STWJDV, Vol. 69, No. 10, p 4-6, January, 1988.

Descriptors: *Administrative regulations, *Operating policy, *Decision making, *Future planning, *Water quality standards, *Utilities, Regulations, Legal aspects, Administrative decisions, Administrative agencies, Policy making, Planning, Standards, Land disposal, Waste disposal, Lead, Heavy metals, Radon, Pollutants, Water pollution, Corrosion control.

The effect of upcoming regulations on the water industry is reviewed. Topics discussed include the role of the Water Utility Council of the American Water Works Association, EPA's regulatory schedule, cost effects and impacts, and immediate issues. The following conclusions are reached: (1) utility managers may have to defer infrastructure replacement and some development in order to meet compliance costs; (2) immediate concerns include the surface treatment rule, standards for lead in drinking water, and the problem of radionuclides, particularly radon; and (3) utility managers and their consulting engineers must develop a working relationship with EPA before draft regulations are prepared to ensure that regulations are based on sound science and cost considerations. (Doria-PTT)
W88-07654

REVIEW OF NEW YORK'S SECTION 208 WATER QUALITY MANAGEMENT PLAN AND PENNSYLVANIA'S COMPREHENSIVE WATER QUALITY MANAGEMENT PLAN FOR INTERSTATE STREAMS,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5G.
W88-07717

DESCRIPTION, LISTING AND COST ESTIMATES OF LOCAL FLOOD WARNING AND EMERGENCY PREPAREDNESS PROGRAMS: SUSQUEHANNA RIVER BASIN, 1985,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6F.
W88-07727

FLOOD DAMAGE REDUCTION MANUAL.
Susquehanna River Basin Commission, Harrisburg, PA. Planning and Operations Div.
For primary bibliographic entry see Field 6F.
W88-07730

ANNUAL REPORT: 1984.
Susquehanna River Basin Commission, Harrisburg, Pennsylvania. 1985. 16 p.

Descriptors: *Susquehanna River, Institutions, *Management planning, Water supply, Water quality, Environmental protection, Recreation, Water management, Annual Reports, Fish, Wildlife.

The Susquehanna River Basin Compact provides that the management of the Basin's resources should be accomplished in accordance with a Comprehensive Plan for the Management and Development of the water resources of the Basin. The Plan sets forth goals and objectives in six major areas of concern - Flood Plain Management and Protection; Water Supply; Water Quality; Watershed Protection and Management; Recreation, Fish and Wildlife; and Cultural Visual and Other Amenities. Fiscal Year 84 activities in furtherance of these objectives are described in this report. (Lantz-PTT)
W88-07731

ANNUAL REPORT: 1985.
Susquehanna River Basin Commission, Harrisburg, Pennsylvania. 1986. 18 p.

Descriptors: *Susquehanna River, Institutions, *Management planning, Water supply, Water quality, Environmental protection, Recreation, Water management, Annual reports, Fish, Wildlife.

The Susquehanna River Basin Compact privides that the management of the Basin's resources should be accomplished in accordance with a Comprehensive Plan for the Managment and Development of the water resources of the Basin. The Plan sets forth goals and objectives in six major areas of concern - Flood Plain Management and Protection; Water Supply; Water Quality; Watershed Protection and Management; Recreation, Fish and Wildlife; and Cultural Visual and Other Amenities. Fiscal Year 85 activities in furtherance of these objectives are described in this report. (Lantz-PTT)
W88-07732

ANNUAL REPORT: 1986.
Susquehanna River Basin Commission, Harrisburg, Pennsylvania. 1987. 19 p.

Descriptors: *Susquehanna River, Institutions, *Management planning, Water supply, Water quality, Environmental protection, Recreation, Water management, Annual reports, Fish, Wildlife.

The Susquehanna River Basin Compact provides that the management of the Basin's resources should be accomplished in accordance with a Comprehensive Plan for the Management and Development of the water resources of the Basin. The Plan sets forth goals and objectives in six major areas of concern - Flood Plain Management and Protection; Water Supply; Water Quality; Watershed Protection and Management; Recreation, Fish and Wildlife; and Cultural Visual and Other Amenities. Fiscal Year 86 activities in furtherance of these objectives are described in this report. (Lantz-PTT)
W88-07733

ANNUAL REPORT: 1982.
Susquehanna River Basin Commission, Harrisburg, PA.
Susquehanna River Basin Commission, Harrisburg, Pennsylvania. 1983. 20 p.

Descriptors: *Susquehanna River, Institutions, *Management planning, *Cowanesque Lake, Water supply, Water quality, Environmental protection, Recreation, Rish migration, Water management, Economic aspects, Annual reports.

The Susquehanna River Basin Compact provides that the management of the Basin's resources should be accomplished in accordance with a Comprehensive Plan for the Management and Development of the water resources of the Basin. The Plan sets forth goals and objectives in six major areas of concern - Flood Plain Management and Protection; Water Supply; Water Quality; Watershed Protection and Management; Recreation, Fish and Wildlife; and Cultural Visual and Other Amenities. Fiscal Year 82 activities in furtherance of these objectives are described in this report. A few of the highlights include participation in hearings before the Federal Energy Regulatory Commission on migratory fish restoration and initiation of an effort to develop water storage capability at the Cowanesque Reservoir. These important activities, along with many others, are summarized in this report. Also included in this year's report is a potential. (Lantz-PTT)
W88-07734

RISK ASSESSMENT AND CONTROL DECISIONS FOR PROTECTING DRINKING WATER QUALITY,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5G.
W88-07817

GUIDELINES FOR CANADIAN DRINKING WATER QUALITY,
Health and Welfare Canada, Tunney's Pasture, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5G.
W88-07818

SOCIAL AND INSTITUTIONAL FACTORS AFFECTING THE ADOPTION AND MAINTENANCE OF AGRICULTURAL BMPS,
Iowa State Univ., Ames. Dept. of Sociology and Anthropology.
For primary bibliographic entry see Field 5G.
W88-07838

DEBRIS MANAGEMENT AT THE LOWER SUSQUEHANNA HYDROELECTRIC PROJECTS: STAFF REPORT,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 8A.
W88-07843

ANNUAL REPORT: 1983.
Susquehanna River Basin Commission, Harrisburg, PA.
Susquehanna River Basin Commission, Harrisburg, Pennsylvania. (1984). 16 p.

Descriptors: *Annual report, *Susquehanna River Basin Commission, *Water quality, Institutions, Cowanesque Lake, Susquehanna River, *New York, *Pennsylvania, *Maryland.

The Susquehanna River Basin Compact was enacted by the States of New York, Pennsylvania and Maryland and the US Government, to provide for the management and proper development of the water and related resources of the Susquehanna River Basin, a 27,500 sq mi area covering portions of the three member states. The Compact also expresses concern about impacts upon the receiving waters of the Chesapeake Bay which takes about one-half of its freshwater inflow from the Susquehanna River. Fiscal Year 83 programs included two notable highlights contained in this year's report: (1) initiation of the Cowanesque Special Studies Program and (2) a water quality survey of the North Branch Susquehanna River. (Lantz-PTT)
W88-07847

6F. Nonstructural Alternatives

EFFECTS OF DIVERSION ON THE NORTH AMERICAN GREAT LAKES,
Rm. 6440, Social Science Bldg., University of Wisconsin, Madison, Wisconsin 53706.
M. H. David, E. F. Joeres, E. D. Loucks, K. W. Potter, and S. S. Rosenthal.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 141-148, February 1988. 8 fig, 3 tab, 10 ref. Federal Grant NA84 AA-D-00065, Project R/PS-30.

Descriptors: *Interbasin transfers, *Great Lakes, *Diversion, *Water demand, *Water level fluctuations, Hydroelectric plants, Navigation, Simulation, Management planning, Water use, Economic impact, Costs.

Water level fluctuations of the Great Lakes often have created regional controversies among the states and Canadian provinces that share this vast resources. Even though the 100-year range of their water levels is only four to five feet, episodes of high and low Great Lakes water levels have been a recurring problem throughout the twentieth century. The possibility of increased diversion and consumptive use has exacerbated the existing conflicts over how to manage this water resource. A research project evaluated the effects of interbasin diversion on the Great Lakes system and on the industries that depend on the maintenance of historical water levels, namely hydropower and commercial navigation. The simulation approach employed in this research and some of the important findings are presented. The approach is similar to that used in recent government studies of Great Lakes water level regulation. Several significant modifications were made specifically addressing the diversion issue. Aggregate annual impacts to hydropower and shipping resulting from a diversion of 10,000 cubic feet per second were found to vary from 60 to 100 million dollars. Increases in impacts as a function of diversion rate are nonlinear for the navigation industry. (Author's abstract)
W88-07287

ALTERNATIVE TO WATER POLLUTION CONTROLS,
Villanova Univ., PA. Dept. of Civil Engineering.
R. A. Chadderton.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 183-187, February 1988. 3 tab, 20 ref.

Descriptors: *Stream pollution, *Water quality control, *Property rights, *Proprietary power, *Recreation, *Economic aspects, Cost allocation, Profit, Ownership of beds, Liability, Financial aspects.

A hypothetical, although realistic, water pollution problem was studied from a property rights viewpoint. Theoretical and economic justifications were developed. A fully-liable, private owner was found to be financially profitable while improving the water quality and providing recreational potential. The example confirmed that property rights provides an answer to stream pollution problems, but contradicted the view that water pollution control must be justified by recreational benefits. (Author's abstract)
W88-07292

CHANGES IN FLOOD INSURANCE IN THE SUSQUEHANNA RIVER BASIN: 1978-1982,
Susquehanna River Basin Commission, Harrisburg, PA.
S. K. Wright, H. J. Painter, and D. J. Dickey.
Publication No. 91. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. August 1984. 55 p, 10 fig, 20 tab.

Descriptors: *Pennsylvania, *New York, *National Flood Insurance Program, *Flood insurance, *Susquehanna River, Buildings, Insurance, Economic aspects, Data collection, Maryland, Public policy, Catchment basins.

Data about the National Flood Insurance Program (NFIP) in the Susquehanna River Basin and the States of New York, Pennsylvania and Maryland for the years 1978-1982 are presented. Information for the following types of buildings are referenced throughout the document: (1) Dwellings - single and multi-unit; (2) Other buildings - commercial, industrial and public buildings; and (3) Total - total for all types of buildings. Data are also compiled in the following categories: (1) Number of policies for dwellings, other buildings and total number of policies; (2) Amount of insurance coverage for dwellings, other buildings and total insurance coverage; (3) Greatest change in the number of policies for 1978 through 1981 compared with 1982; (4) Greatest change in the amount of insurance coverage for 1978 through 1981 compared with 1982; (5) Average policy value; and (6) Average premium per policy. This report is prepared in six parts: Part I describes changes in the number of municipalities enrolled in the National Flood Insurance Program; Part II describes various changes in flood insurance in the Susquehanna River Basin for 1978 through 1982; Part III shows changes in flood insurance coverage for each of the eight Susquehanna River subbasins; Part IV consists of six tables that tabulate flood insurance data for each county in the Susquehanna River Basin; Part V shows flood insurance data for those portions of New York, Pennsylvania and Maryland in the Susquehanna River Basin; and in Part VI, statewide flood insurance data for New York, Pennsylvania and Maryland is provided for comparison purposes. (Lantz-PTT)
W88-07715

SUMMARY OF DATA ON STREAM REACHES AND MAPPING COVERAGE USED FOR FLOOD INSURANCE STUDIES.
Susquehanna River Basin Commission, Harrisburg, PA. Div. of Planning and Operation.
Publication No. 90. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. 1984. 98 p.

Descriptors: *Flood insurance, *Pennsylvania, *Susquehanna River Basin, *Data collections, *Mapping, Topography, Streamflow, Flood plain zoning, Historic floods, Hydrology.

The Susquehanna River Basin Commission (SRBC) has completed 245 municipal flood insurance studies under two separate contracts with the Federal Emergency Management Agency (FEMA), formerly the Federal Insurance Administration, U.S. Department of Housing and Urban Development (FIA, HUD). These studies included most of the major population centers throughout the Susquehanna River Basin. To complete these studies, SRBC prepared topographic mapping of the study reaches at a scale of 1 in = 200 ft with 5-foot contour intervals. A detailed hydrologic study of most stream reaches was conducted and water surface profiles for the 10-, 50-, 100-, and 500-year flooding events were calculated. Recognizing the value of the base mapping and calculations that were completed for the studies, SRBC staff has maintained an extensive data file and has provided information on request, to private citizens, consulting firms, and public agencies at all levels of government. This document lists the streams and municipalities that were studied under each contract. The stream reaches and municipalities are presented from the most downstream to upstream locations for the first two sections of this listing. The third section lists the municipalities that were studied, types of mapping available for each, and the number of sheets of each type of mapping to cover the study area for each municipality. (Lantz-PTT)
W88-07716

IMPLICATIONS OF CHANGES IN FLOOD INSURANCE IN THE SUSQUEHANNA RIVER BASIN (A FIRST ASSESSMENT),
Susquehanna River Basin Commission, Harrisburg, PA.
S. K. Wright, E. E. Seay, and H. J. Painter.
Publication No. 101. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. October 1985. 20 p, 8 fig, 4 tab.

Descriptors: *Flood insurance, *Susquehanna River, *Costs, *Pennsylvania, Economic aspects, Susquehanna River basin, Public participation, Floods, Tropical storms, Behavior, National Flood Insurance Program.

Changes have occurred in flood insurance coverage during the past few years that can have a significant bearing on the economic impact of flooding in the Susquehanna River Basin. There are several factors which affect the number of flood insurance policies and the amount of flood insurance coverage. The first involves community eligibility for the flood insurance program. There has been a steady increase in the number of communities eligible for the program and many communities have converted from the emergency to the regular program. With increased municipal entry into the National Flood Insurance Program, and conversion from the emergency to the regular program, one would expect to see both growth in the number of individuals enrolled in the program and increased levels of coverage. Insurance coverage per policy has increased at about 7% per year; however, the number of enrollees has declined. The cost of flood insurance is the second major factor affecting participation in the program. Average premium cost for flood insurance policies in the Susquehanna River Basin has increased from $69 in 1978 to $179 in 1983. No doubt much of the decline observed in the number of flood insurance policies and amount of insurance coverage can be attributed to rate increases. Another factor influencing participation in the flood insurance program is the amount of reimbursement a policy owner expects to receive following flood damage. Still another factor has been the changing economic conditions of the past few years. A final factor affecting participation in the flood insurance program is the length of time since the last major flood. It has been 10 years since the flooding of Tropical Storm Eloise in 1975 and 13 years since Tropical Storm Agnes in 1972. Over time, individual concern about the impacts of flooding erodes. (Lantz-PTT)
W88-07721

DESCRIPTION, LISTING AND COST ESTIMATES OF LOCAL FLOOD WARNING AND EMERGENCY PREPAREDNESS PROGRAMS: SUSQUEHANNA RIVER BASIN, 1985,
Susquehanna River Basin Commission, Harrisburg, PA.
S. K. Wright.
Publication No. 93. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. February 1985. 33 p, 2 tab, 2 append.

Descriptors: *Flood protection, *Costs, *Susquehanna River, *Policy making, *Local governments, *New York, *Pennsylvania, *Management planning, Case studies, County jurisdiction, Local government, Flood damage, Tropical storms, Emergency preparedness, Public participation, Gages, Communications, Flooding.

Following the destruction caused by Tropical Storms Agnes in 1972 and Eloise in 1975, local organizations, volunteer groups and governments developed numerous flood warning systems and emergency preparedness plans to reduce flood damage. Descriptions of local systems, their location and local (non-Federal) costs of operating the system in the Susquehanna River basin are summarized in this report. Some of the flood warning and emergency preparedness activities carried out by county government include: operation communications and radio dispatch centers serving all emergency functions; organize and maintain self-help flood warning systems, including recruiting and training volunteers, erecting stream gages, distributing rain gages and maintaining equipment; elected county officials supervise county emergency response, make disaster decisions, and direct county resources; and, in most counties County Emergency Management Services and/or County Planning Departments are responsible for organization and maintenance of flood warning systems. Local government actions include: municipal officials declare emergencies and direct and coordinate flood damage reduction actions; municipal police patrol roads, rivers and streams during high water periods; operate small area or neighborhood flood warning systems; erect barricades on flooded streets or highways; operate and maintain emergency communications systems; organize and operate evacuation centers; move furniture and personal possessions of homeowners who will be flooded; provide assistance to industries and businesses in evacuating or reducing flood damages; carry out flood fighting activities such as sand bagging, erecting levee or wall closures, and other actions; rescue stranded or isolated people; and, fire companies are the most important pre-flood damage reduction organization in many communities. In spite of little planning or training assistance, efforts by fire companies have reduced flood damages for many individuals and businesses. (Lantz-PTT)
W88-07727

FLOOD DAMAGE REDUCTION MANUAL.
Susquehanna River Basin Commission, Harrisburg, PA. Planning and Operations Div.
Publication No. 78. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. 1982. 59 p, 2 tab, append.

Descriptors: *Flood damage, *Manuals, *Flood control, *Local governments, Public policy, Hydrological regime, Hydraulic engineering, Flood protection, Public participation, Susquehanna River Basin Commission.

The Susquehanna River Basin Commission recognizes that state and federal governments are limited in the kind of assistance they can provide to local governments in dealing with their flooding problems and the damages incurred, sometimes annually, by inundation. The purpose of this manual is to provide step-by-step guidelines on how to implement flood damage reduction measures at the local government level. The manual can be used by government officials, citizens' groups, or environmental or service organizations - anyone interested in finding solutions to flooding problems. The manual describes how to gather community support for a flood-damage reduction program. It details the most common types of flooding and offers a general explanation of the hydrologic and hydraulic engineering techniques used to better understand the mechanics of flooding. The most important and lengthy section of the manual outlines the most effective and practical, structural and nonstructural flood-damage reduction measures that can be implemented. In this section, the objectives of these actions, their advantages and desadvantages are discussed. The manual also provides a section with information on streams in the Susquehanna River basin. There, individualized

tables contain general data such as the drainage areas of the stream as well as what kind of studies have been done in specific areas and where to obtain additional information. (Lantz-PTT)
W88-07730

CHANGES IN FLOOD INSURANCE IN THE SUSQUEHANNA RIVER BASIN: 1980-1981,
Susquehanna River Basin Commission, Harrisburg, PA.
S. K. Wright, and H. J. Painter.
Publication No. 77. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. March 1982. 13 p, 4 tab.

Descriptors: *Flood protection, *Insurance, *Susquehanna River, Costs, Economic aspects, Flood plain management.

As part of the Susquehanna River Basin Commission's continuing evaluation of flood plain management, a comparison was made between the number of flood insurance policies and flood insurance coverage on June 30, 1980 and July 31, 1981. In this time period, there were substantial reductions in the number of flood insurance policies in force and a small decrease in the amount of flood insurance coverage. There was a reduction of 7,347 in the number of insurance policies (11%) from 67,050 policies to 59,703 policies in force. There was a reduction of $37.928 million in flood insurance coverage, or 2%, from $1.969 billion to $1.931 billion. In Pennsylvania, some counties had increases and others decreases in the amount of flood insurance coverage. The largest increase was in Luzerne County. The $734.7 million insurance coverage in Luzerne County is 38% of the entire basin insurance coverage. Other counties with increases were Northumberland, Lancaster, York, Schuylkill and Dauphin. Decreases occurred in Blair, Clearfield, Bradford and Tioga Counties. The $4.9 million decrease in Blair County was a 20% reduction in flood insurance coverage. (Lantz-PTT)
W88-07739

SELF-HELP FLOOD DAMAGE REDUCTION AT BLOOMSBURG, PENNSYLVANIA: A CASE STUDY,
Susquehanna River Basin Commission, Harrisburg, PA.
S. K. Wright.
Publication No. 94. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. April 1985. 20 p, 2 fig, 1 tab.

Descriptors: *Flood damage, *Flood protection, Bloomsburg, Pennsylvania, Costs, Benefits, Case studies, Flooding.

Self-help flood damage reduction in Bloomsburg is significant. In December 1983 over $3.5 million of flood damage reduction benefits were realized by these actions. Evacuation or the protection of over 400 vehicles alone is a significant benefit. This report identifies the magnitude of benefits that are possible through a coordinated community effort to: (1) identify the flood problems; (2) develop practical cost effective methods of flood damage reduction; and (3) implement them at the community level. Timely flood warning, knowledge of how varying flood levels will affect the community and an organized flood evacuation program are the basic components of a practical, integrated and comprehensive flood damage reduction program. This case history looked only at the actions taken in Bloomsburg during the flood of December 13-15, 1983. It should be noted that Bloomsburg experienced flooding events in February and April 1984 that reached about the same flood stages (the three floods had flood elevations that were within a foot of each other). Therefore, the benefits summarized in this report for the flood of December 1983 were repeated in February and April 1984 providing clear evidence that self-help flood damage reduction actions in Bloomsburg are of major importance in protecting and preserving the economic vitality of the community. Community recognition of the importance of these actions has increased significantly. (Lantz-PTT)
W88-07844

USERS MANUAL FOR FLOOD EVACUATION PLANNING OF WATER AND WASTEWATER TREATMENT PLANTS,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5D.
W88-07849

6G. Ecologic Impact Of Water Development

HELIUM SURVEY FOR DELINEATING AREAS OF KARST-SUFFOSION PROCESSES CAUSED BY HIGH-RATE GROUNDWATER WITHDRAWAL,
Water Problems Institute, USSR Academy of Sciences, Moscow, USSR.
For primary bibliographic entry see Field 2F.
W88-06878

GROUNDWATER RESOURCES AND DEVELOPMENT IN CHINA,
Ministry of Geology and Mineral Resources, Beijing, China.
For primary bibliographic entry see Field 2F.
W88-06879

SEISMICITY AROUND BRAZILIAN DAM RESERVOIRS,
University of Western Ontario,, Department of Geology, N6A 5B7, London, Ontario.
For primary bibliographic entry see Field 8E.
W88-06880

FACTORS CONTROLLING PRIMARY PRODUCTION IN TWO DIVERTED RIVERS WITH A LARGE FLOW REDUCTION (FACTEURS CONTROLANT LA PRODUCTION PRIMAIRE DANS DEUX RIVIERES SOUMISES A UNE FORTE REDUCTION DE DEBIT),
Department of Biological Sciences, University of Quebec at Montreal, C.P. 8888, Succ. A, Montreal, Quebec.
L. Lapierre, and D. Planas.
Hydrobiologia HYDRB8, Vol. 153, No. 2, p 109-119, October 20, 1987. 3 fig, 5 tab, 36 ref.

Descriptors: *Environmental effects, *Rivers, *Diversion, *Primary productivity, *Phytoplankton, Algae, Biomass, Water quality, Flow control, Nutrients.

The effects of river diversion on phytoplankton primary production and biomass in the downstream part of two rivers were studied in relation to physical and chemical variables. The Opinaca and Little Opinaca, situated north of the 52nd parallel, are oligotrophic with phytoplankton primary production of <10.76 mg C/sq m/hr, chlorophyll a of <3.0 mg/cu m, and biomass of 118-1007 mg/cu m. Nutrient levels (phosphorus and nitrogen) did not increase in either river. In fact, one river showed a significant decrease in nutrient levels. The decrease in flow favored establishment of an algal biomass about 2 times greater than that present before diversion. In one river the increased biomass was associated with a 2.5-fold increase in primary productivity. In the other river the primary production per unit of surface area remained stable but increased when expressed by unit volume due to a great decrease in underwater light penetration as a result of an increase in suspended inorganic particulates. (Cassar-PTT)
W88-06895

ZOOPLANKTON OF A SMALL TROPICAL RESERVOIR (SOLOMON DAM, NORTH QUEENSLAND),
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
For primary bibliographic entry see Field 5G.
W88-06915

IMPACTS OF HYDROELECTRIC DEVELOPMENT ON RIPARIAN VEGETATION IN THE SIERRA NEVADA REGION,
Oregon State Univ., Corvallis. Dept. of Forest Science.
R. R. Harris, C. A. Fox, and R. Risser.
Environmental Management EMNGDC, Vol. 11, No. 4, p 519-527, August 1987. 3 fig, 3 tab, 28 ref.

Descriptors: *Sierra Nevada, *Hydroelectric plants, *Riparian vegetation, *Environmental effects, Ecological effects, Vegetation effects, Diverson, Streamflow.

Fourteen streams in the Sierra Nevada in the USA were sampled to determine whether diversions of streamflow for hydroelectric development had caused significant changes in riparian vegetation. Several streams showed significant differences in vegetation cover, community composition, or community structure between pairs of diverted and undiverted reaches. On some streams, environmental conditions rather than streamflow diversions may have been responsible for vegetation differences. Streams in the Sierra Nevada respond individualistically to diversions. Prediction of vegetation responses must take into consideration environmental characteristics of specific stream reaches. (Author's abstract)
W88-06968

WETLAND DEVELOPMENT TRENDS IN COASTAL NORTH CAROLINA, USA, FROM 1970 TO 1984,
Duke Univ., Durham, NC. School of Forestry.
M. B. Stockton, and C. J. Richardson.
Environmental Management EMNGDC, Vol. 11, No. 5, p 649-657, September 1987. 5 fig, 3 tab, 22 ref. OTA Grant 233-4550.

Descriptors: *Coastal marshes, *Coastal zone management, *Floodplains, *Wetlands, *Dredging, *North Carolina, Permits, Flood control, Bulkheads, Canals, Fill permits, Regional development.

Coastal wetlands are a valuable resource to North Carolina, representing important habitat for marine organisms and providing flood control areas and buffer zones from marine storms. An analysis of wetland development trends in coastal North Carolina from 1970 to 1984 was conducted using over 3000 files containing 15 years of permitting records. The total amount of coastal wetland area altered due to authorized development under the Coastal Area Management Act (CAMA), the Dredge and Fill Law, and Section 404 of the Federal Water Pollution Control Act is 1740 ha. This represents nearly 2% of the salt marsh wetlands along the coast of North Carolina. The number of permits issued steadily increased during the 1980s; however, the total amount of wetland loss decreased each year. A few large projects in the early 1970s accounted for nearly 70% of all wetland area developed during the 15-year period. Nearly two-thirds of all projects involving wetland destruction involved impacts on high marsh ecosystems. Bulkheads, canals, and filling activities made up 80% of the projects requiring permits; 62% of the permits were issued to private landowners, but this group accounted for only 16% of the losses of wetland area. Utility companies, which accounted for < 1% of the permits issued, were responsible for 46% of the permitted wetland loss during the 15-year study period. Future studies should address agriculture and forestry practices which are exempt under CAMA laws and therefore their effects on wetland alteration have not been quantified. (Author's abstract)
W88-06973

ECOLOGICAL EFFECTS OF COASTAL MARSH IMPOUNDMENTS: A REVIEW,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. L. Montague, A. V. Zale, and H. F. Percival.
Environmental Management EMNGDC, Vol. 11, No. 6, p 743-756, November 1987. 1 fig, 2 tab, 145 ref. U.S. Fish and Wildlife Service Cooperative Agreement 14-16-0009-1544.

Descriptors: *Nutrients, *Environmental effects, *Estuaries, *Literature reviews, *Coastal marshes, *Marshes, Ecological effects, Aquatic habitats,

Habitats, Ecosystems, Waterfowl, Dikes, Reservoirs, Dams, Organic matter, Food, Wildlife, Nitrogen, Phosphorus, Tidal effects, Salinity, Fish, Mosquito control, Seagrass, Mangroves.

The effects of diking and flooding marshes (impounding) for mosquito control and waterfowl management are reviewed. Major changes include an increase in water level, a decrease in salinity, and a decrease in the exchange of marsh water with estuarine water. Dramatic changes in species composition occur; they vary from place to place. For example, emergent vegetation (grassy or mangrove) may change to submerged vegetation, cattails often proliferate due to decreased salinity and other favorable conditions, black mangrove marshes change to red and white mangroves, nutrients decrease from reduced water circulation or increase from wastes of newly attracted wildlife, primary production may increase due to a reduction in salinity or decrease due to salt concentration by evaporation. Changes in overall production and transport phenomena may not be as great as commonly believed. Export seems to be reduced or less likely in marshes that have little groundwater discharge and are far from tidal creeks, are low in creek density, and open to estuarine water, are not near upland runoff or river discharge, have pools and considerable entrapping vegetation, and are in areas of low frequency and amplitude of flooding. Marshes above mean high water often fit such a description. An important concern is occasional barring of free access to open water when conditions become unfavorable in an impounded marsh that is periodically opened and closed. For example, in summer high temperatures and depleted oxygen can cause fish kills in an impounded marsh because no access to better conditions is readily available as in a natural marsh. Collection of comparative data on the estuarine animal use of various configurations of natural and impounded marshes should lead to improved management of both impounded and unimpounded marshes. (Cassar-PTT)
W88-07100

BASIC HYDROLOGIC STUDIES FOR ASSESSING IMPACTS OF FLOW DIVERSIONS ON RIPARIAN VEGETATION: EXAMPLES FROM STREAMS OF THE EASTERN SIERRA NEVADA, CALIFORNIA, USA,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. M. Kondolf, J. W. Webb, M. J. Sale, and T. Felando.
Environmental Management EMNGDC, Vol. 11, No. 6, p 757-769, November 1987. 7 fig, 1 tab, 19 ref. Dept. of Energy Contract No. DE-AC05-84OR21400.

Descriptors: *Environmental effects, *Streams, *Data acquisition, *Riparian vegetation, *Flow control, *Diversion, Vegetation, Mapping, Aerial photography, Regulated flow, Seasonal variation, Owens River Basin, California, Water table fluctuations, Hydrographs, Flow measurement, Mountain streams, Model studies, Flood plains, Streamflow depletion.

Stream diversion for hydroelectric development can adversely affect riparian vegetation by flow reduction, for example, lowered stream surface levels affecting plants dependent on spray or submersion, water table lowered below the rooting depths of some species, and reduction of annual high flows which recharge bank sediments with moisture. Methods for collecting relevant hydrologic data are described, and the results are reported for studies on seven stream reaches proposed for hydroelectric development in the eastern Sierra Nevada, California. Methods include (1) preparing geomorphic maps from aerial photographs, (2) using well level records to evaluate the influence of streamflow on the riparian water table, (3) taking synoptic flow measurements to identify gaining and losing reaches, and (4) analyzing flow records from an upstream-downstream pair of gages to document seasonal variations in downstream flow losses. In the study area the geomorphic influences on hydrology and riparian vegetation were pronounced. For example, in a large U-shaped glacial valley, the width of the riparian strip was highly variable along the study reach and was related to geomorphic controls, whereas the study reaches on alluvial fan deposits had relatively uniform geomorphology and riparian strip width. Flow losses of 20% were typical over reaches on alluvial fans. In a mountain valley, however, one stream gained up to 275% from geomorphically controlled groundwater conditions. (Cassar-PTT)
W88-07101

WATER TABLE RISE IN A SEMICONFINED AQUIFER DUE TO SURFACE INFILTRATION AND CANAL RECHARGE,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-07205

EVALUATION OF COSTS ASSOCIATED WITH REGIONAL, ENVIRONMENTAL IMPACT IN CHESAPEAKE BAY,
West Virginia University, Morgantown, WV.
For primary bibliographic entry see Field 6B.
W88-07224

THAILAND DAM CONTROVERSY,
E. Kemf.
Water Resources Journal, No. 154, p 82-83, September 1987.

Descriptors: *Environmental effects, *Dams, *Hydroelectric power, *Thailand, Wildlife habitats, Habitats, Social effects, Roads, Construction, Forests.

The environmental impact of the proposed Nam Choan dam in Thailand upstream of the River Kwai is the subject of much controversy. Road construction has already opened wildlife areas, promoting illegal logging, poaching, and settlement of six new villages. Conservationists claim that dam construction would reduce the remaining lowland riverine forest habitat by one-third. Other adverse effects would be disturbance of migration routs of endangered species, further salination of downstream agricultural land, danger of earthquake, and flooding of unexplored archeological sites, potential mineral resources, and Karen and Hmong tribal villages. The project is temporarily shelved pending the results of a feasibility study. (Cassar-PTT)
W88-07559

DEPRESSION OF PRIMARY PRODUCTION BY HUMIC MATTER AND SUSPENDED SEDIMENT IN LIMNOCORRAL EXPERIMENTS AT SOUTHERN INDIAN LAKE, NORTHERN MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W88-07638

UNIONID MUSSELS (MOLLUSCA, BIVALVIA) OF THE BELGIAN UPPER RIVER MEUSE: AN ASSESSMENT OF THE IMPACT OF HYDRAULIC WORKS ON THE RIVER WATER SELF-PURIFICATION,
Liege Univ. (Belgium). Zoology Inst.
R. M. Libois, and C. Hallet-Libois.
Biological Conservation BIOCOK, Vol. 42, No. 2, p 115-132, 1987. 4 fig, 5 tab, 30 ref.

Descriptors: *Mussels, *River Meuse, *Water quality, *Hydraulic structures, *Environmental impact, *Dams, *Self-purification, *Benthic fauna, *Banks, Mollusks, Weirs, Water level, Sampling, Mapping, Benthic environment, Aquatic animals, Benthos, Fauna, Biomass, Filtration.

In September, 1983, the nine weirs regulating the flow of the River Meuse between Givet, France and Namur, Belgium were kept fully open for technical purposes. The water level therefore dropped, allowing the sampling of benthic organisms and the mapping of the different kinds of banks. The density of unionid mussels was measured for each bank type. Silt and fine gravel bottoms are the preferred habitats of these mussels. In these natural habitats, the mean biomass is estimated at more than 1.8 tons/ha. In pebbles, this value is near 1 ton/ha, whereas in the stony blocks and on rocky bars it falls to 165 kg/ha. Man-made banks are poor biotopes, with 297 kg mussels/ha on old stoneworks and only 65 kg/ha on recent ones. When the filtration rate is considered, it can be shown that, at the time this study was undertaken, the unionid mussels living on the Meuse banks filtered more than 300 l water/s. This rate will drop to 27 l/s within only a few years if the proposed hydraulic works are constructed. It is concluded that these works will have a negative effect on the self-purification capacity of the river. (Author's abstract)
W88-07670

7. RESOURCES DATA

7A. Network Design

ESTIMATING SAMPLE REQUIREMENTS FOR FIELD EVALUATIONS OF PESTICIDE LEACHING,
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
C. N. Smith, R. S. Parrish, and R. F. Carsel.
Environmental Toxicology and Chemistry ETOCDK, Vol. 6, No. 5, p 343-357, May 1987. 7 fig, 3 tab, 19 ref.

Descriptors: *Pesticides, *Pesticide residues, *Leaching, *Groundwater pollution, *Sampling, *Soil chemistry, *Soil physical properties, Statistical analysis, Chemical degradation, Sorption, Soil solution, Variation coefficient, Inorganic compounds, Hydraulic conductivity, Hydrogen ion activity, Infiltration.

A method is presented for estimating the number of samples needed to evaluate pesticide leaching threats to ground water at a desired level of precision. Sample size projections are based on desired precision (exhibited as relative tolerable error), level of confidence (90 or 95%) and estimates of variability (expressed as the coefficient of variation) for selected pesticide and soil characteristics. Summary tables of descriptive statistics are provided as guides for projecting variability of various soil characteristics, pesticide properties (sorption, degradation), pesticide concentration profiles and inorganic solutes. These data were compiled through a comprehensive search of review articles and of reports of laboratory and field studies. They are also useful for evaluating ground water contamination by calibrating and conducting sensitivity testing with solute transport models. Coefficients of variation for selected soil characteristics were as follows: bulk density, 2 to 17%; organic matter, 42 to 125%; porosity, 4 to 18%; particle size distribution, 3 to 55%; hydrogen ion activity, 2 to 15%; 0.3 bar water content, 18 to 82%; 15 bar water content, 18 to 87%; saturated hydraulic conductivity, 48 to 320%; and infiltration rate, 40 to 97%. Coefficients of variation for selected pesticide characteristics were as follows: transformation rates, 7 to 202%; sorption coefficients, 34 to 56%; and pesticide concentration profiles, 40 to 450%. Variability of pesticide concentrations increased over time after the initial pesticide application. The coefficients of variation for inorganic solutes ranged from 19 to 127%. On the basis of these data, sample size estimates (for constant desired precision and confidence level) for characterizing selected soil characteristics generally are smaller than those required for estimating pesticide concentrations. Fewer samples are projected for estimating pesticide concentrations shortly after application, with progressive increases required in later sampling. (Author's abstract)
W88-06943

MICROSCALE CHEMICAL HETEROGENEITY IN GROUNDWATER,
Isotope Department, The Weizmann Institute of Science, 7100 Rehovot, Israel.
For primary bibliographic entry see Field 5B.

W88-07113

SULFATE IN COLORED WATERS: II. EVALUATION OF APPROACHES FOR CORRECTING HISTORICAL COLORIMETRIC DATA,
National Water Research Inst., Burlington (Ontario). Analytical Methods Div.
V. Cheam, and A. S. Y. Chau.
Environment International ENVIDV, Vol. 13, No. 3, p 261-270, 1987. 11 fig, 2 tab, 12 ref.

Descriptors: *Sulfates, *Acid rain, *Water analysis, *Chemical analysis, *Data collections, *Colorimetric data, *Colorimetry, *Color, *Data correction, *Canada, History, Seasonal variations, Organic matter, Chromatography, Dissolved solids.

Historical colorimetric sulfate data are known to be highly biased and cannot be used as reliable Sulfate ion concentrations for scientific interpretation. They need to be corrected. Various approaches for correcting these data were discussed and evaluated. A simple and direct approach was found to be satisfactory. To correct historical colorimetric data, data sets are first categorized and grouped together based on geographical locations and seasonal variations of dissolved carbon (or color) of a specific site, river, lake (or groups) which have similar amounts and nature of organic matter. For each group, the colorimetric and chromatographic sulfate values are then obtained and related by an equation which is used to convert the corresponding historical values to 'true' sulfate values. (Author's abstract)
W88-07131

INFLUENCE OF INSTALLATION PRACTICES ON EVAPORATION FROM SYMON'S TANK AND AMERICAN CLASS A-PAN EVAPORIMETERS,
Hydrological Research Institute, Department of Water Affairs, Private Bag X313, Pretoria, 0001, Republic of South Africa.
H. H. Bosman.
Agricultural and Forest Meteorology, Vol. 41, No. 3/4, p 307-323, December 1987. 2 fig, 9 tab, 14 ref.

Descriptors: *Evaporimeters, *Evaporation pans, *Statistical analysis, Environmental effects, Vegetation effects, Screens, Sodium chloride, Copper sulfate, Solutes, Field tests.

Results from Symon's tanks and American Class A-pans proved that the nature of the immediate environment has a pronounced influence on evaporation. Class A-pans above bare soil and crushed stone (both without protective screening) evaporated 6 and 19%, respectively, more than that above grass cover. Bare soil treatments with protective screening evaporated 18% less than those without protection. Symon's tanks surrounded by bare soil and crushed stone evaporated 13 and 12%, respectively, more than tanks surrounded by grass. Symon's tanks in bare soil with protective screens, averaged 16% less evaporation than those without screening. A-pan treatments on different wooden bases above bare soil showed random differences for monthly evaporation, although these differences were not significant on an annual basis. Annual evaporation for sodium chloride and copper sulfate treatments did not differ significantly from control values. (Author's abstract)
W88-07186

MEASURE OF ISOTOPIC EQUILIBRIUM BETWEEN WATER, WATER VAPOUR AND SOIL CO2 IN ARID ZONE SOILS,
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
For primary bibliographic entry see Field 2G.
W88-07197

ESTIMATING FLOOD PEAKS FROM SMALL RURAL CATCHMENTS IN SWITZERLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2E.
W88-07202

DISAGGREGATION OF DAILY RAINFALL,
Pima County Department of Transportation and Flood Control, 1313 S. Mission Road, Tucson, AZ 85713.
For primary bibliographic entry see Field 2B.
W88-07208

COMBINED HYDROLOGIC SAMPLING CRITERIA FOR RAINFALL AND STREAMFLOW,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. G. Tarboton, R. L. Bras, and C. E. Puente.
Journal of Hydrology JHYDA7, Vol. 95, No. 3/4, p 323-339, 30 November 1987. 8 fig, 1 tab, 11 ref. USGS Grant 14-08-0001-G1143.

Descriptors: *Sampling, *Hydrologic data, *Water sampling, *Rainfall, *Streamflow, *Rainfall-runoff relationships, *Hydrologic models, *Sampling strategy, Errors, Catchment basins, Estimating, Streamflow forecasting, Discharge measurement, Stochastic process, Mathematical models, Geomorphology, Systems analysis, Linear programming, Analysis of variance, Rain gages, Flow measurement.

This paper considers the joint sampling of the rainfall and streamflow processes. The sampling frequencies in time and space are obtained as a function of basin and rainfall characteristics. The effectiveness of different sampling strategies is measured by the variance of the error of estimated or predicted streamflow. This is related to the rainfall and basin rainfall-discharge properties through parameterizations of these processes. Rainfall is modelled as a stochastic process with covariance structure separable in time and space. Streamflow is parameterized in terms of the fluvial geomorphology of the basin. Linear systems theory is used to link precipitation to flow and to compute the variance of basin discharge. The variance of the error in prediction of streamflow is computed in terms of the following: (1) basin and rainfall model parameters; and (2) measurement strategy consisting of numbers of rain gages plus rainfall and flow measurement intervals. This error variance is used to assess the effectiveness of a measurement strategy. The results should be of use in the formulation of hydrologic sampling strategies. (Author's abstract)
W88-07209

WIND SET-UP ERROR IN MEAN LAKE LEVELS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W88-07512

RAPID STATISTICAL CORRELATION BETWEEN POLLUTION SOURCES AND MARINE CONCENTRATIONS,
Institute of Oceanography, Bulgarian Academy of Sciences, 9000 Varna, Bulgaria.
For primary bibliographic entry see Field 5A.
W88-07697

NUTRIENT MONITORING OF THE LOWER SUSQUEHANNA RIVER AND SELECTED TRIBUTARIES, OCTOBER 1, 1984 - SEPTEMBER 30, 1986: INTERIM REPORT,
Susquehanna River Basin Commission, Harrisburg, PA.
J. R. Hollowell.
Publication No. 108. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. February 1987. 25 p, 13 fig.

Descriptors: *Water quality, *Monitoring, *Susquehanna River, *Nutrients, Chesapeake Bay, Storm runoff, Runoff, Urban areas, Forest watersheds.

Significant contributions of nutrients and sediments are derived from storm induced overland runoff. Collecting samples of storm induced runoff has been moderately successful. Improved capability is needed in predicting when approaching storm systems will produce sufficient runoff to warrant sampling. A full assessment of nutrient loading from the monitored Main Stem Susquehanna River stations and tributary stations needs additional storm induced runoff data. These data are also needed to evaluate the combined effect of seasons and land use on storm loading. This preliminary analysis has also shown that further monitoring of the urban (Paxton Creek) and forested (Stony Creek) sites is not warranted and that greater emphasis should be placed on the principal nutrient and sediment contributing basins. Although data from the Main Stem Susquehanna River monitoring stations were not assessed in this report (due to insufficient storm data), it is now apparent that an increased monitoring effort is necessary downstream of the Harrisburg station. The storm loads carried by the River are modified by the hydroelectric power generating impoundments. To define this nutrient loading to the Chesapeake Bay more fully, it is necessary to implement a coordinated storm sampling effort between the tributary and Main Stem stations described above and the Conowingo Dam station maintained by the Maryland Office of Environmental Protection and the U.S. Geological Survey. (Lantz-PTT)
W88-07737

DETAILED GEOLOGIC STUDIES ESTABLISH PERMEABILITY TRENDS FOR PLUME DEFINITION AND GROUND-WATER CLEAN-UP,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
V. Price, and W. C. Fallaw.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010197. Price codes: A03 in paper copy, A01 in microfiche. Report No. DP-MS-86-181, (1987). 37 p, 32 fig.

Descriptors: *Geohydrology, *Permeability, *Groundwater pollution, *Path of pollutants, Model studies, Monitoring, Groundwater quality, Piezometers, Infiltration, Groundwater movement, Aquitards, South Carolina.

Heterogeneity is the hallmark of near shore (fluvial to marginal marine) depositional sequences. Because of this, simple geologic models derived from cursory sampling or the more basic electric logs may not define permeability trends adequately for plume definition and contaminant mitigation efforts. A study area in the upper Atlantic Coastal Plain of South Carolina is discussed. Preliminary geologic and hydrologic data were incorporated into a three-dimensional flow model which predicted piezometric contours at right angles to observed contours. In addition, contaminated groundwater was observed in locations that were considered to be upgradient of known sources based on preliminary assessment of piezometric data from a few early monitoring wells. Installation of later monitoring wells was accompanied by thorough and careful geologic sampling and collection of digitally-captured geophysical log data. Isopach and structure contour maps were constructed for significant high and low permeability strata. Probable middle Eocene erosion resulted in replacement of clays in an important aquitard with permeable channel sands over a small part of the study area. Discovery of breaches in the confining layers permitted observed patterns of contaminant distribution and piezometric data to be explained. (Author's abstract)
W88-07743

MEASUREMENT OF SEDIMENT YIELDS,
Ward (Peter) and Associates, Vancouver (British Columbia).
For primary bibliographic entry see Field 2J.
W88-07898

ANALYTICAL METHODS MANUAL FOR THE DIRECT/DELAYED RESPONSE PROJECT SOIL SURVEY,
Lockheed Engineering and Management Services Company Inc., Las Vegas, NV 89119.
K. A. Cappo, L. J. Blume, G. A. Raab, J. K. Bartz, and J. L. Engles.
Available from the National Technical Information

Service, Springfield, VA. 22161, as PB87-227468. Price codes: A14 in paper copy, A01 in microfiche. August 1987. 196 p, 8 fig, 24 tab, 79 ref, 5 append. Contract No. 68-03-3249.

Descriptors: *Acid rain, *Watersheds, *Data collections, *Spectroscopy, *Air pollution effects, *Soil properties, Data processing, Acidity, Acidic water, Surface water, Emission spectroscopy, Atomic absorption spectroscopy, Chemistry of precipitation, Model studies, Manuals, Surveys, Soil water, Prediction.

The U.S. Environmental Protection Agency (EPA), in conjunction with the National Acid Precipitation Assessment Program, has designed and implemented a research program to predict the long-term response of watersheds and surface waters in the United States to acidic deposition. On the basis of this research, each watershed system studied will be classified according to the time scale in which it will reach an acidic steady state, assuming current levels of acidic deposition. The EPA requires that data collection activities be based on a program that ensures that the resulting data are of known quality and are suitable for the purpose for which they are intended. In addition, it is necessary that the data obtained be consistent and comparable throughout the survey. For these reasons, the same detailed analytical methodology must be available to and must be used by all analysts participating in the study. This manual specifies the analytic methods and internal quality control used to process and analyze samples for the Direct/Delayed Response Project Soil Survey. The described determinations, and their methods, include: for air-dry moisture content, gravimetric; for cation exchange capacity (using NH4OAc and NH4Cl saturating solutions), autotitration or flow injection analyzer; and for exchangable K in NH4OAc, NH4Cl, and CaCl2, flame atomic absorption spectroscopy or flame atomic emission spectroscopy. (Author's abstract)
W88-07960

IN SITU MONITORING OF ORGANICS,
Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV. Nevada Test Site.
P. T. Dickman, and D. A. McGrath.
IN: DOE Hazardous Waste Remedial Actions Program, Annual Report: FY 1986. Report No. DOE/HWP--25, May 1987. p 169-178, 5 fig.

Descriptors: *Monitoring, *Sampling, *Path of pollutants, *In situ tests, *Organic compounds, Soil sampling, Waste disposal, Disposal sites, Gas chromatography, Chemical analysis, Tracers.

The purpose of this task was to demonstrate the use of subsurface soil-gas samples and tracers in characterizing and monitoring organic pollutant releases from disposal facilities. The basic concept involves inserting subsurface gas sampling probes at various depths and locations at the release site and drawing small volumes of gas samples into a gas chromatograph for analysis. Data obtained provide a qualitative characterization of the presence of volatile organics and a distribution profile. Quantitative analysis requires laboratory data on soil properties and material sorption characteristics. Once a site has been characterized for organics, subsurface gaseous tracers can be released to assess migration mechanisms and rates. In FY 1986, three major tasks were accomplished: (1) design of soil air sampler probes, (2) development of standard laboratory procedures for quantifying volatile organic sorption, and (3) development of procedures in the use and analysis of sampling systems and data. Over the next fiscal year, investigation of a jet fuel spill site will be started using the soil-gas samplers. Laboratory tests are being performed on soils from the area and principal constituents of jet fuel. After the initial characterization steps have been completed, some simplified modeling will be performed to determine optimal locations for long-term monitoring stations and tracer studies. (See also W88-07971) (Lantz-PTT)
W88-07977

SOIL GAS SENSING FOR DETECTION AND MAPPING OF VOLATILE ORGANICS,
Nevada Univ., Las Vegas. Environmental Research Center.
D. A. Devitt, R. B. Evans, W. A. Jury, T. H. Starks, and B. Eklund.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-228516. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/8-87/036, August 1987. 266 p, 80 fig, 34 tab, 172 ref, append. EPA Contract No. CR 812189-01.

Descriptors: *Monitoring, *Sampling, *Soil gas, *Mapping, *Organic compounds, *Volatile acids, *Path of pollutants, Solute transport, Soil contamination, Groundwater movement, Groundwater pollution, Chemical analysis, Sampling.

Soil gas monitoring is a cost effective means of delineating the size and movement of organic contaminants in the subsurface. It can also provide immediate information on the lateral extent of soil and groundwater combination and can minimize and more accurately predict the number and location of conventional monitoring wells that must be drilled. Five important areas related to soil gas monitoring are addressed; (1) site specific parameter considerations, (2) transport and retention of organics in soil and groundwater, (3) sampling methods, (4) analytical methods, and (5) statistical treatment of soil organic vapor measurements. Many of the parameters (water solubility, microbial influence, groundwater flow, etc) that must be considered by the scientist before utilizing soil gas sensors in a field monitoring program are outlined. The complex soil, air, water and hydrocarbon system is addressed with an overview of the important processes involved in the transport and fate of organic contaminants in the soil. The correct sampling and analytical methodologies for monitoring volatile organics in the subsurface include such sampling methods as headspace, ground probe, flux chamber and passive sampling techniques. The most appropriate methods to utilize for a given contaminant monitoring program are considered. A statistical treatment of soil organic vapor measurements is also included to ensure that soil gas monitoring programs address the requirement for data precision. The spatial patterns of soil organic vapor measurements are treated from a statistical viewpoint. (See also W88-07971)(Lantz-PTT)
W88-07979

7B. Data Acquisition

STUDY OF METAL SORPTION/DESORPTION PROCESSES ON COMPETING SEDIMENT COMPONENTS WITH A MULTICHAMBER DEVICE,
University of Technology Hamburg-Harburg, Eissendorferstrasse 38, D-2100 Hamburg, 90, West Germany.
For primary bibliographic entry see Field 5B.
W88-06885

USE OF LANDSAT MULTISPECTRAL SCANNER DATA FOR THE ANALYSIS AND MANAGEMENT OF FLOODING ON THE RIVER SEVERN, ENGLAND,
Department of Geography, University of Leicester, Leicester LE1 7RH, U.K.
A. G. Brown, K. J. Gregory, and E. J. Milton.
Environmental Management EMNGDC, Vol. 11, No. 5, p 695-701, September 1987. 4 fig, 3 tab, 24 ref.

Descriptors: *Flooding, *Flood-mapping, *Landsat, *Hydrological management, *Remote sensing, Satellite technology.

Remote sensing has emerged as one of the major techniques for the analysis and delineation of large floods. This analysis can provide data invaluable for the hydrological management of large river systems. A need for information on the extent of floodplain inundation for the lower reaches of the largest river in the UK was met by a search through Landsat images of floods and the analysis of the best example recorded. Automated classification of the Landsat imagery of this flood on the river Severn in 1977 was used to provide estimates of the extent and spatial distribution of inundation. Flood images were generated using the Plessey IDP 3000 image processor, and the maps derived accorded well with aerial photography and qualitative flood information. Three distinct floodplain environments were delineated and flood images produced by different spectral bands compared. Specific questions prompted by flood hazard management and concerning the processes and extent of flooding were answered by the Landsat data analysis. Management of the flood risk of large rivers is expensive and remote sensing data is a relatively cheap and effective way of monitoring control works and providing data for the prediction of the effects of future hydrological works. Remote sensing is a practical way in which spatial information concerning the behavior of large dynamic systems can be obtained both quickly and relatively cheaply. (Author's abstract)
W88-06974

DUAL-LABEL RADIOISOTOPE METHOD FOR SIMULTANEOUSLY MEASURING BACTERIAL PRODUCTION AND METABOLISM IN NATURAL WATERS,
George Mason Univ., Fairfax, VA. Dept. of Biology.
R. B. Jonas, J. H. Tuttle, D. L. Stoner, and H. W. Ducklow.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 3, p 791-798, March 1988. 9 fig, 2 tab, 23 ref. NOAA Grant NA84AA-D-00014 and EPA Grant X-003311-01-0.

Descriptors: *Analytical methods, *Radioactive tracers, *Limnology, *Primary productivity, *Dual-label method, *Microbiological studies, Microorganisms, Bacterial physiology, Turnover rate, Amino acids, Phytoplankton, Seasonal variation, Bacteria, Chesapeake Bay.

Bacterial production and amino acid metabolism in aquatic systems can be estimated by simultaneous incubation of water samples with both tritiated methyl-thymidine and 14C-labeled amino acids. This dual-label method not only saves time, labor, and materials, but also allows determination of these two parameters in the same microbial subcommunity. Both organic carbon incorporation and respiration can be estimated. The results obtained with the dual-label technique are not significantly different from single-radiolabel methods over a wide range of bacterial activity. The method is particularly suitable for large-scale field programs and has been used successfully with eutrophic estuarine samples as well as with oligotrophic oceanic water. In the mesohaline portion of Chesapeake Bay, thymidine incorporation ranged seasonally from 2 to 635 pmol/L/h and amino acid turnover rates ranged from 0.01 to 28.4%/h. Comparison of thymidine incorporation with amino acid turnover measurements made at a deep, midbay station in 1985 suggested a close coupling between bacterial production and amino acid metabolism during most of the year. However, production-specific amino acid turnover rates increased dramatically in deep bay waters during the spring phytoplankton bloom, indicating transient decoupling of bacterial production from metabolism. Ecological features such as this are readily detectable with the dual-label method. (Author's abstract)
W88-07024

USE OF ECHOSOUNDER TRACINGS TO ESTIMATE THE ABOVEGROUND BIOMASS OF SUBMERGED PLANTS IN LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
C. M. Duarte.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 4, p 732-735, April 1987. 2 fig, 1 tab, 12 ref, append.

Descriptors: *Echosounding, *Biomass, *Submerged plants, *Lakes, *Limnology, *Data acquisition, *Estimating, Aquatic plants, Estimating equations, Macrophytes, Errors.

A method is presented to estimate the above-ground biomass of submerged macrophytes in lakes from echosounder tracings and from the growth form of the dominant species in the stand. The equation is: Biomass = -343 + 37.7(cu height) + 953(form x height) where species that reach the surface to flower are categorized as form class 1, short understory species with floating flowers as form class 2, and species with underwater flowers, those lacking flowers, and those that, although able to produce flower, never flower in nature as form class 3. The standard error of the estimates is 421 g fresh weight/sq m, a value comparable with the standard error of direct harvest by SCUBA divers. The echosounder-based method is limited to stands growing at depths greater than 70 cm with plants taller than 20 cm. (Author's abstract)
W88-07078

BASIC HYDROLOGIC STUDIES FOR ASSESSING IMPACTS OF FLOW DIVERSIONS ON RIPARIAN VEGETATION: EXAMPLES FROM STREAMS OF THE EASTERN SIERRA NEVADA, CALIFORNIA, USA,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 6G.
W88-07101

CONTINUOUS-FLOW DETERMINATION OF MANGANESE IN NATURAL WATERS CONTAINING IRON,
Institute of Oceanographic Sciences, Brook Road, Wormley, Godalming, Surrey GU8 5UB (Great Britain).
D. J. Hydes.
Analytica Chimica Acta ACACAM, Vol 199, p 221-226, August 15, 1987. 2 fig, 4 tab, 5 ref.

Descriptors: *Water analysis, *Chemical analysis, *Manganese, *Heavy metals, *Iron, *Formaldoxime, *Natural waters, Continuous flow analyzer, Automation.

A re-evaluation of the use of formaldoxime to determine manganese in natural waters at concentrations of 0-100 micromolar is reported. Addition of EDTA after formation of the manganese/formaldoxime complex removes interference from up to 100 micromolar iron. The extents of formation and destruction of the iron and manganese complexes with formaldoxime depend on the pH of the solution and on the time between reagent addition and measurement of absorbance. (Author's abstract)
W88-07121

CONSTRUCTION AND EXPLOITATION OF AN AUTOMATIC SEQUENTIAL WET-ONLY RAIN SAMPLER,
Laboratoire de physico-chimie de l'atmosphere, Universite Paris 7, 2 Place Jussieu, 75251, Paris Cedex 05, France.
For primary bibliographic entry see Field 5B.
W88-07150

ESTIMATION OF SURFACE WATER EVAPORATION RATES BY CONTINUOUS RADIOGAUGING,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
For primary bibliographic entry see Field 2D.
W88-07183

SIMPLE NON-WEIGHING LYSIMETER INSTALLATION WITH RAIN SHELTER,
Department of Soil Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Nainital, 263145, India.
R. P. Tripathi, H. S. Kushwaha, and A. Agrawal.
Agricultural and Forest Meteorology, Vol. 41, No. 3/4, p 275-288, December 1987. 7 fig, 1 tab, 32 ref.

Descriptors: *Lysimeters, *Groundwater irrigation, *Subsurface irrigation, *Groundwater level, *Groundwater management, Soil water table, Evapotranspiration, Water stress, Field tests, Surface irrigation, Moisture profiles, Groundwater depletion.

The design and performance of a low-cost lysimeter installation with water table control and rain shelters is discussed. The installation consists of 18 lysimeters in three rows of six each at a spacing of 15 m within rows and 30 m between rows. Each row represents soil and water table conditions of one of three soil series. This facilitates variable irrigation levels with possible replications. The water table is controlled by regulating the water supply through a well point installed in the porous bed underlying the soil in each lysimeter tank. When water table contribution to evapotranspiration (ET) exceeds 0.6 mm/day, water is allowed to drip from a stopcock at a rate proportional to the average daily fall in the water table during the preceding 2 days. For lower groundwater contribution rates the required amount of water is added manually through the well point, once daily. The lysimeter is suitable for ET and crop water stress studies under shallow water table conditions. ET is calculated from adding surface irrigation, profile moisture depletion as measured by a neutron probe, and rate of water supply to maintain a constant water table level. The rain shelter consists of an iron frame, over which a 4 by 4 m tarpaulin can be unrolled manually; it could also be motorized. The lysimeter and removable shelter ensure a natural environment of the crop and are durable, except for the tarpaulin, which needs replacement after about 3 years. (Author's abstract)
W88-07184

SEMI-EMPIRICAL MODEL FOR CALCULATING EVAPORATION AND TRANSPIRATION FROM WETLAND RICE,
Division of Agricultural and Food Engineering, Asian Institute of Technology, P.O. Box 2754, Bangkok 10501, Thailand.
For primary bibliographic entry see Field 2D.
W88-07185

INFLUENCE OF INSTALLATION PRACTICES ON EVAPORATION FROM SYMON'S TANK AND AMERICAN CLASS A-PAN EVAPORIMETERS,
Hydrological Research Institute, Department of Water Affairs, Private Bag X313, Pretoria, 0001, Republic of South Africa.
For primary bibliographic entry see Field 7A.
W88-07186

SIMPLE METHOD TO ESTIMATE SPECIFIC EQUILIBRIUM SOIL-WATER CONTENT IN A UNIFORM SOIL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2G.
W88-07189

FINITE-ELEMENT SIMULATION OF LOW-TEMPERATURE, HEAT-PUMP-COUPLED, AQUIFER THERMAL ENERGY STORAGE,
Kent State Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-07190

ELLIPTICAL INHOMOGENEITIES IN GROUNDWATER FLOW: AN ANALYTICAL DESCRIPTION,
National Institute of Public Health and Environmental Hygiene (RIVM), P.O. Box 1, 3720 MA Bilthoven, The Netherlands.
For primary bibliographic entry see Field 2F.
W88-07194

LINEAR GRAPHICAL METHOD FOR DETERMINING HYDRODISPERSIVE CHARACTERISTICS IN TRACER EXPERIMENTS WITH INSTANTANEOUS INJECTION,
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
For primary bibliographic entry see Field 5B.
W88-07198

CONCEPTUAL CATCHMENT MODEL FOR ESTIMATING SUSPENDED SEDIMENT FLOW,
G. B. Pant University of Agriculture and Technology, Pantnagar 263 145, U. P., India.
For primary bibliographic entry see Field 2J.
W88-07199

SYNOPTIC EVAPOTRANSPIRATION MODEL APPLIED TO TWO NORTHERN FORESTS OF DIFFERENT DENSITY,
For primary bibliographic entry see Field 2D.
W88-07201

ESTIMATION OF AVERAGE AREAL EVAPOTRANSPIRATION: PROPOSAL TO MODIFY MORTON'S MODEL BASED ON THE COMPLEMENTARY CHARACTER OF ACTUAL AND POTENTIAL EVAPOTRANSPIRATION,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 2D.
W88-07203

PREDICTING GROUNDWATER FLOW IN A PHREATIC AQUIFER,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-07204

TYPE CURVES IN PATCHY AQUIFERS,
Department of Hydraulics, Civil Engineering Faculty, Technical University of Istanbul, Ayazaga, Istanbul, Turkey.
For primary bibliographic entry see Field 2F.
W88-07206

RECURSIVE ESTIMATION OF KERNELS OF NONLINEAR RAINFALL-RUNOFF MODELS,
Dames and Moore, 4950 West Kennedy Boulevard, Suite 410, Tampa, FL 33609.
For primary bibliographic entry see Field 2A.
W88-07210

LAKE WATER COLOR: COMPARISON OF DIRECT OBSERVATIONS WITH UNDERWATER SPECTRAL IRRADIANCE,
Water Quality Centre, MWD, Private Bag, Hamilton, New Zealand.
R. J. Davies-Colley, W. N. Vant, and R. J. Wilcock.
Water Resources Bulletin WARBAQ, Vol. 24, No. 1, p 11-18, February 1988. 3 fig, 1 tab, 16 ref.

Descriptors: *Optical properties, *Reflectance, *Absorption, *Refractivity, *Water quality, *Color, *Lakes, Irradiance spectra, Limnology, Water analysis.

The water color in 14 lakes of diverse optical character has been computed from near-surface upwelling irradiance spectra recorded by a submersible spectroradiometer. In these lakes the hues corresponding to irradiance spectra are in reasonable agreement with Munsell hue matches obtained directly by observation in the field. The simple field technique for hue matching using the Munsell standards was broadly validated by this spectroradiometric study. The technique is recommended for further study by limnologists water resource managers as a potential additional tool for characterizing waters. (Author's abstract)
W88-07272

FIELD INVESTIGATIONS OF THE NATURE OF WATER-TABLE RESPONSE TO PRECIPITATION IN SHALLOW WATER-TABLE ENVIRONMENTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2B.
W88-07295

ESTIMATES OF SPECIFIC YIELD WITH THE GEOELECTRIC RESISTIVITY METHOD IN GLACIAL AQUIFERS,
Rhode Island Univ., Kingston. Dept. of Geology.
R. K. Frohlich, and W. E. Kelly.

Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 33-44, January 15, 1988. 7 fig, 3 tab, 28 ref. NSF Grant No. 7819408.

Descriptors: *Glacial aquifers, *Aquifer characteristics, *Geophysics, *Specific yield, *Soil saturation, *Soil porosity, *Electrical studies, *Saturation zone, Subsurface drainage, Water resistivity, Aeration zone, Depth sounding, New England.

Specific yield is the volume of water that drains from a saturated soil due to gravity relative to this total volume. Methods to determine this hydrogeologic parameter depend on well tests and well sample analyses. Low-cost surface geoelectrical depth sounding after Schlumberger is suggested as an alternative method to estimate specific yield. This method is based on a determination of the layer resistivities for the saturated and unsaturated zone and on the water resistivity. Porosity and the degree of saturation are estimated from the electrical resistivity according to Archie's Law. Specific yields estimated with the suggested geophysical method agree with estimates after Preuss and Todd which are based on porosity and median grain size data. Uncertainties between resistivities and porosity and saturation exist due to generalized assumptions on material constants in Archie's Law. For the range of specific yield estimates between 18 and 36% the constants seem to be valid. The method after Preuss and Todd requires a detailed evaluation of porosity and median grain size; it produces best results for D sub 50 values that are larger than 0.3 mm. These values can vary considerably vertically as well as horizontally in the glacial aquifers derived mainly from fluvial outwash of the receding glaciers in southern New England. (Author's abstract)
W88-07296

VARIABILITY OF SOIL MOISTURE DIFFUSIVITY OF LOAMY TO SILTY SOILS ON MARL, DETERMINED BY THE HOT AIR METHOD,
Department of Physical Geography, Geographical Institute, University of Utrecht, Heidelberglaan 2, 3508 TC Utrecht (The Netherlands).
For primary bibliographic entry see Field 2G.
W88-07309

ENVIRONMENTAL STATUS OF BISMUTH AND ITS TRACE ANALYSIS ON ALLOYS, PLANT TISSUES, ANIMAL TISSUES AND WATERS AS TERNARY COMPLEX WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND A PYRIDYLAZO REAGENT,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
For primary bibliographic entry see Field 5A.
W88-07435

RAPID SYNERGISTIC EXTRACTION AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF IRON IN ENVIRONMENTAL SAMPLES USING TRIBUTYL PHOSPHATE AND N-PHENYL-2-FURYLACRYLOHYDROXAMIC ACID,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
For primary bibliographic entry see Field 5A.
W88-07436

SOIL MOISTURE MEASUREMENT BY AN IMPROVED CAPACITANCE TECHNIQUE: I. SENSOR DESIGN AND PERFORMANCE,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2G.
W88-07525

SOIL MOISTURE MEASUREMENT BY AN IMPROVED CAPACITANCE TECHNIQUE: II. FIELD TECHNIQUES, EVALUATION AND CALIBRATION,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2G.
W88-07526

AIRBORNE RIVER-ICE THICKNESS PROFILING WITH HELICOPTER-BORNE UHF SHORT-PULSE RADAR,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W88-07536

SURFACE GEOELECTRICS FOR GROUNDWATER POLLUTION AND PROTECTION STUDIES,
Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia).
O. Mazac, W. E. Kelly, and I. Landa.
Journal of Hydrology JHYDA7, Vol. 93, No. 3-4, p 277-294, September 15, 1987. 9 fig, 2 tab, 43 ref.

Descriptors: *Groundwater pollution, *Geophysical studies, *Groundwater, *Water pollution detection, *Geohydrology, *Surface geoelectrics, *Electrical studies, *Water pollution, Pollutants, Water quality.

Surface geoelectrical methods are currently used in solving a range of hydrogeological problems involving both quality and quantity issues. In the first of two papers devoted to the use of applied geophysics in solving problems of groundwater protection and pollution detection attention is focused on the fundamental principles of geophysical surveying for pollution and protection studies. Geoelectrical methods, in particular resistivity methods, which are the most widely applicable geophysical method were analyzed. Relations between geoelectrical and hydrogeological parameters are discussed with a view to groundwater pollution, as well as methods of measurements and the principles of geophysical and hydrogeological interpretation of results. Several examples are given to illustrate the principles. (Author's abstract)
W88-07564

DESIGN AND USE OF A COLLECTOR FOR THE IN SITU ISOLATION OF PARTICULATE TRACE ORGANIC SPECIES IN PRECIPITATION,
Oregon State Univ., Newport. Hatfield Marine Science Center.
For primary bibliographic entry see Field 5A.
W88-07614

ENHANCED FLUORESCENCE DETECTION OF DANSYL DERIVATIVES OF PHENOLIC COMPOUNDS USING A POSTCOLUMN PHOTOCHEMICAL REACTOR AND APPLICATION TO CHLOROPHENOLS IN RIVER WATER,
Dept. of Analytical Chemistry, Free Univ., De Boelelaan 1083, 1081 HV Amsterdam, The Netherlands.
For primary bibliographic entry see Field 5A.
W88-07633

DETERMINATION OF TRACE METALS IN MARINE BIOLOGICAL REFERENCE MATERIALS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY,
Analytical Chemistry Section, Chemistry Div., National Research Council of Canada, Ottawa, Ontario, Canada K1A 0R9.
For primary bibliographic entry see Field 5A.
W88-07634

DETERMINATION OF TRIBUTYLTIN IN TISSUES AND SEDIMENTS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Moss Landing Marine Labs., California Dept. of Fish and Game, Moss Landing, California 95039.
For primary bibliographic entry see Field 5A.
W88-07635

PC-BASED DATA ACQUISITION SYSTEMS FOR SMALL UTILITIES,
Micro Specialty Systems, Inc., Northampton, Pennsylvania.
W. W. Noderer.
Water Engineering and Management WENMD2, Vol. 135, No. 1, p 36, 39-40, January, 1988.

Descriptors: *Computers, *Automation, *Utilities, *Data acquisition, *Cost analysis, Economic aspects, Technology, Performance evaluation.

A basic guide is provided for evaluating personal computer systems and adapting them to the specific needs of small water utilities. Input/output hardware should be evaluated for accuracy, flexibility, distribution, speed, ruggedness, and maintenance requirements. As for software, implementation of a package that does not truly address the objectives of a small utility is the single most critical reason for failure of a data acquisition system not living up to expectations. Specifications to be considered include real-time multitasking operation, on-line calculation, and extensive disk write capacity. Overall performance factors include ease of use and customization capability. It is suggested that software be purchased from a vendor who supplies and supports complete systems. Hasty purchase decisions may be prevented by a rational systems approach; a list of standard objectives is provided. (Doria-PTT)
W88-07649

LARGEST COMPOSTING SYSTEM TAKES ORDERS FROM PC,
Department of Environmental Services, Portland, Oregon.
For primary bibliographic entry see Field 5E.
W88-07650

WATER METER TESTING TO RAISE REVENUES: AN ABSOLUTE NECESSITY IN A DIFFICULT ECONOMY,
The Ford Meter Box Company, Wabash, Indiana.
G. R. Barker.
Southwest and Texas Water Works Journal STWJDV, Vol. 69, No. 3, p 4-6, June, 1987. 5 ref.

Descriptors: *Water metering, *Testing procedures, *Inspection, *Maintenance, *Cost analysis, *Economic aspects, Costs, Conservation, Water conservation, Maintenance costs, Utilities, Calibration, Flow, Water conveyance.

Methods of water meter testing are reviewed. Topics discussed include the need for testing, meter testing parameters, determining equipment needs, and other testing options. It is concluded that a properly designed meter testing program will pay for itself many times over in enhanced revenues, lowered meter replacement costs, and better customer relations. Meter testing programs should be monitored regularly to determine whether or not meters are being tested at the most cost-efficient point in their service life; this is the point at which the increased return in revenue brought about by meter testing and replacement equals the cost of testing and replacement. These costs can be kept down by using properly designed equipment and shop layouts. (Author's abstract)
W88-07651

USING LANDSAT MULTISPECTRAL SCANNER DATA TO ESTIMATE SUSPENDED SEDIMENTS IN MOON LAKE, MISSISSIPPI,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
J. C. Ritchie, C. M. Cooper, and J. Yongqing.
Remote Sensing of Environment RSEEA7, Vol. 23, No. 1, p 65-81, October, 1987. 7 fig, 9 tab, 46 ref.

Descriptors: *Remote sensing, *Satellite technology, *Data acquisition, *Data interpretation, *Suspended sediments, *Spectral analysis, *Moon Lake, Mississippi, Sediments, Lake sediments, Lakes, Water quality management, Ecosystems, Aquatic ecosystems, Regression analysis, Mathematical analysis, Conservation, Soil conservation.

Research was undertaken to determine the application of digital spectral data collected by the multispectral scanner (MSS) on the Landsat satellite for

estimating suspended sediments in aquatic ecosystems where mean annual concentrations of suspended sediments are >50 mg/L. Digital spectral data from 14 Landsat MSS scenes of Moon Lake in Coahoma County, MS were analyzed and compared with ground measurements of total solids and suspended sediments in the lake surface water for the period between January, 1983 and May, 1985. Coefficients of determination >0.81 were calculated between MSS Band 2 (0.6-0.7 microns) or Band 3 (0.7-0.8 microns) and suspended sediments or total solids. Coefficients of determination for multiple regression using three or four MSS bands were >0.90. This study showed that digital spectral data from the Landsat satellites can be used to locate and monitor surface-suspended sediments in aquatic ecosystems. With such a digital computer technique, entire regions can be surveyed quickly to locate aquatic ecosystems with suspended sediment problems. (Doria-PTT)
W88-07657

REMOTE SENSING SCIENCE APPLICATIONS IN ARID ENVIRONMENTS,
Nevada Univ., Reno. Dept. of Range, Wildlife and Forestry.
P. T. Tueller.
Remote Sensing of Environment RSEEA7, Vol. 23, No. 2, p 143-154, November, 1987. 1 fig, 53 ref.

Descriptors: *Remote sensing, *Arid lands, *Land management, *Reviews, *Technology, *Data interpretation, *Watershed management, Wildlife management, Range management, Wildlife habitats, Deserts, Vegetation, Land reclamation, Species diversity, Spectral analysis, Soil types, Infrared imagery.

The use of remote sensing in aridland/rangeland regions to meet the need for low cost management information over large expanses of land is reviewed. Applications include rangeland management, watershed analysis, antidesertification, wildlife habitat management, mine waste reclamation, management of the arid land-irrigated agriculture interface, and outdoor recreation. Unique remote sensing problems in arid regions are related to sparse vegetation, multiple species, and considerable bare ground. Therefore, spectral interpretations must consider: (1) multiple intermingled green and senescent species; (2) considerable bare ground which includes cryptogamic soil crusts and powdery, endurated, or salinized surfaces; (3) standing dead vegetation; (4) litter; and (5) shadows. Pixel modeling will be required in these heterogeneous environments. In particular, the lack of greenness tends to preclude the application of vegetation indices based on infrared/red ratios. New interpretation approaches to scene understanding are described that should lead to useful procedures for aridlands. (Author's abstract)
W88-07658

SATELLITE REMOTE SENSING OF DROUGHT CONDITIONS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
C. J. Tucker, and B. J. Choudhury.
Remote Sensing of Environment RSEEA7, Vol. 23, No. 2, p 243-251, November, 1987. 2 fig, 31 ref.

Descriptors: *Remote sensing, *Satellite technology, *Drought, *Calibrations, *Photosynthesis, *Reflectance, Optical properties, Microwaves, Radiation, Technology, Reviews, Spectral analysis, Distribution, Temporal distribution, Vegetation.

Two satellite-based methodologies for detecting drought conditions were compared in historical perspective at regional and continental scales. Polar-orbiting meteorological satellite data in the NOAA series of operational satellites can be used to detect drought conditions manifested by deficiencies in photosynthetic capacity of terrestrial vegetation. This method is illustrated by maximum NDVI value from August-September 1984-1986 using 4-km AVHRR data. The other methodology, which is new, involves the use of NIMBUS-7 SMMR 37 GHz data for detecting the water present in vegetation. Examples from Africa north of the equator indicate substantial promise for these data in drought monitoring. The SMRR data compare favorably with the AVHRR data while exhibiting a higher sensitivity in low-density vegetation situations. (Author's abstract)
W88-07659

INSTANTANEOUS DELINEATION OF CONVECTIVE RAINFALL AREAS USING SPLIT WINDOW DATA OF NOAA-7 AVHRR,
Meteorological Research Institute, Tsukuba, Ibaraki 305, Japan.
For primary bibliographic entry see Field 2B.
W88-07684

DEVELOPMENT OF CLOUD PARTICLE VIDEO SONDE,
Meteorological Research Institute, Tsukuba, Ibaraki 305, Japan.
For primary bibliographic entry see Field 2B.
W88-07686

REMOTE AND IN SITU OBSERVATIONS OF SIERRA NEVADA WINTER MOUNTAIN CLOUDS: RELATIONSHIPS BETWEEN MESOSCALE STRUCTURE, PRECIPITATION AND LIQUID WATER,
U.S. Bureau of Reclamation, Auburn, California.
For primary bibliographic entry see Field 2B.
W88-07691

RUNOFF COLLECTOR AND FLUME FOR USE ON BARE FALLOW PLOTS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
P. I. A. Kinnell.
Journal of Agricultural Engineering Research JAERA2, Vol. 38, No. 2, p 99-104, October 1987. 2 fig, 4 ref.

Descriptors: *Measuring instruments, *Flow measurement, *Erosion plots, *Runoff, *Runoff rates, *Gages, *Sedimentation, Flow rates, Flumes, Soil erosion, Data acquisition, Hydraulics.

A runoff collector and flume described allow collection of runoff from the bottom of erosion plots and permit measurement of the runoff rate without many of the usual problems associated with the deposition of sediment in the flume which would alter the hydraulic characteristics of the flow measuring device. The design is only suitable for use in situations where the runoff does not contain a great deal of solid material other than soil. The design is used for the collection of runoff from bare fallow runoff and soil loss plots at Ginninderra Experiment Station, Australia, but is applicable to erosion plots operating under similar conditions. Variations in the height, width, and cross-sectional shape of the flume can be used to alter the depth-discharge relationship to suit particular needs. The width of the plot that can be serviced by two lateral channels at right angles to the long dimension of the 2.6 m wide and 41 m long plot with a bottom width of 2.5 cm and a non-vertical side on their downstream side is limited to only a few meters, particularly where low slope gradients prevent installation of equipment at the outfall of the flume. The lateral channels are designed to have a bottom slope of 1 in 8 and this, together with their small bottom width, ensures that no sediment is deposited in the lateral channels at all runoff rates. The design incorporates a rectangular flume which conveys the water away from the bottom of the plot and provides a measuring section for which a depth-discharge curve can be determined to facilitate the measurement of runoff rates. An electrical capacitance technique is used for measuring water depths in the flume since it does not introduce a structure which may impede the flow or be clogged by sediment. (Wood-PTT)
W88-07694

RE-EVALUATION OF THE WELL PERMEAMETER AS A FIELD METHOD FOR MEASURING HYDRAULIC CONDUCTIVITY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W88-07700

CLEANUP OF BIOLOGICAL EXTRACTS BY A PASTEUR PIPETTE COLUMN AND A COMPARISON OF IN VIVO-ACCUMULATED CHLORINATED PESTICIDE RESIDUES WITH OTHER CLEANUP SYSTEMS,
Chemistry Branch, Biological and Chemical Research Institute, PMB 10, Rydalmere, NSW, 2116, Australia.
For primary bibliographic entry see Field 5A.
W88-07713

WATER USE DATA IN THE SUSQUEHANNA BASIN, PART I: STATUS OF DATA COLLECTION.
Susquehanna River Basin Commission, Harrisburg, PA. Planning and Operations Div.
For primary bibliographic entry see Field 7C.
W88-07725

COLOR INFRARED VIDEO MAPPING OF UPLAND AND WETLAND COMMUNITIES,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
H. E. Mackey, J. R. Jensen, M. E. Hodgson, and K. W. O'Cuilinn.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010202. Price codes: A02 in paper copy, A01 in microfiche. Report No. DP-MS--86-210, (1987). 15 p, 7 fig, 11 ref. DOE Contract No. DE-AC09-76SR00001.

Descriptors: *Wetlands, *Mapping, *Infrared imagery, *Videotaping, *South Carolina, *Data acquisition, *Data interpretation, Maps, Remote sensing, Forests, Vegetation.

Color infrared images were obtained using a video remote sensing system at 3,000 and 5,000 ft over a variety of terrestrial and wetland sites on the Savannah River Plant near Aiken, SC. The terrestrial sites ranged from secondary successionnal old field areas to even aged pine stands treated with varying levels of sewage sludge. The wetland sites ranged from marsh and macrophyte areas to mature cypress-tupelo swamp forests. The video data were collected in three spectral channels, 0.5-0.6 micrometers, 0.6-0.7 micrometers, and 0.7-1.1 micrometers at a 12.5 mm focal length. The data were converted to digital form and processed with standard techniques. Comparisons of the video images were made with aircraft multispectral scanner (MSS) data collected previously from the same sites. The analyses of the video data indicated that this technique may present a low cost alternative for evaluation of vegetation and landcover types for environmental monitoring and assessment. (Author's abstract)
W88-07782

ORGANIC POLLUTANTS IN WATER: SAMPLING, ANALYSIS, AND TOXICITY TESTING.
For primary bibliographic entry see Field 5A.
W88-07783

CONCENTRATION TECHNIQUES FOR ISOLATING ORGANIC CONSTITUENTS IN ENVIRONMENTAL WATER SAMPLES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5A.
W88-07784

INTERIM PROCEDURES FOR PREPARING ENVIRONMENTAL SAMPLES FOR MUTAGENICITY (AMES) TESTING,
S-CUBED, Division of Maxwell Labs., San Diego, CA.
For primary bibliographic entry see Field 5A.
W88-07785

CONCENTRATION TECHNIQUES AIMED AT THE ASSIGNMENT OF ORGANIC PRIORITY POLLUTANTS,
National Inst. of Public Health and Environmental

Hygiene, P.O. Box 150, 2260 AD Leidschendam, The Netherlands.
For primary bibliographic entry see Field 5A.
W88-07786

APPLICATION OF THE MASTER ANALYTICAL SCHEME TO POLAR ORGANIC COMPOUNDS IN DRINKING WATER,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5A.
W88-07788

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR DETERMINATION OF TRACE ORGANIC COMPOUNDS IN AQUEOUS ENVIRONMENTAL SAMPLES: ASSESSMENT OF CURRENT AND FUTURE CAPABILITIES,
Monsanto Agricultural Co., St. Louis, MO. Life Sciences Research Center.
For primary bibliographic entry see Field 5A.
W88-07789

FUNDAMENTAL APPROACH TO REVERSE-OSMOSIS CONCENTRATION AND FRACTIONATION OF ORGANIC CHEMICALS IN AQUEOUS SOLUTIONS FOR ENVIRONMENTAL ANALYSIS,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-07790

COMPARISON OF HIGH MOLECULAR WEIGHT ORGANIC COMPOUNDS ISOLATED FROM DRINKING WATER IN FIVE CITIES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-07792

SYNTHETIC POLYMERS FOR ACCUMULATING ORGANIC COMPOUNDS FROM WATER,
Ames Lab., IA.
For primary bibliographic entry see Field 5A.
W88-07793

POTENTIAL ORGANIC CONTAMINATION ASSOCIATED WITH COMMERCIALLY AVAILABLE POLYMERIC SORBENTS: CONTAMINANT SOURCES, TYPES, AND AMOUNTS,
Environmental Research and Technology, Inc., Concord, MA.
For primary bibliographic entry see Field 5A.
W88-07794

EVALUATION OF THE PREPARATION OF RESIN SAMPLERS FOR BROAD SPECTRUM ANALYSIS OF LARGE-VOLUME SAMPLES,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5A.
W88-07795

ISOLATION OF ORGANIC ACIDS FROM LARGE VOLUMES OF WATER BY ADSORPTION ON MACROPOROUS RESINS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5A.
W88-07796

USE OF LARGE-VOLUME RESIN CARTRIDGES FOR THE DETERMINATION OF ORGANIC CONTAMINANTS IN DRINKING WATER DERIVED FROM THE GREAT LAKES,
Health and Welfare Canada, Tunney's Pasture, Ottawa (Ontario). Monitoring and Criteria Div., Environmental Health Directorate.
For primary bibliographic entry see Field 5A.
W88-07797

BROAD SPECTRUM ANALYSIS OF RESIN EXTRACTS: A BASE EXTRACTION CLEANUP PROCEDURE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5A.
W88-07798

SOLVENT EXTRACTION USING A POLYMER AS SOLVENT WITH AN AMPEROMETRIC FLOW-INJECTION DETECTOR,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-07799

EVALUATION OF BONDED-PHASE EXTRACTION TECHNIQUES USING A STATISTICAL FACTORIAL EXPERIMENTAL DESIGN,
Smith Kline and French Labs., Philadelphia, PA.
For primary bibliographic entry see Field 5A.
W88-07800

USE OF GEL PERMEATION CHROMATOGRAPHY TO STUDY WATER TREATMENT PROCESSES,
Lyonnaise des Eaux Central Lab., 38 rue du President Wilson 78230, Le Pecq, France.
For primary bibliographic entry see Field 5F.
W88-07801

MUTAGEN ISOLATION METHODS: FRACTIONATION OF RESIDUE ORGANIC COMPOUNDS FROM AQUEOUS ENVIRONMENTAL SAMPLES,
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
For primary bibliographic entry see Field 5A.
W88-07802

COMPARISON OF SEVEN METHODS FOR CONCENTRATING ORGANIC CHEMICALS FROM ENVIRONMENTAL WATER SAMPLES,
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5A.
W88-07803

EVALUATION OF REVERSE OSMOSIS TO CONCENTRATE ORGANIC CONTAMINANTS FROM WATER,
Gulf South Research Inst., New Orleans, LA.
For primary bibliographic entry see Field 5A.
W88-07804

EVALUATION OF AN INTEGRATED ADSORPTION METHOD FOR THE ISOLATION AND CONCENTRATION OF TRACE ORGANIC SUBSTANCES FROM WATER,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-07805

ISOLATION OF ORGANIC COMPOUNDS PRESENT IN WATER AT LOW CONCENTRATIONS USING SUPERCRITICAL FLUID CARBON DIOXIDE,
Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 5A.
W88-07806

RECOVERY OF TRACE ORGANIC COMPOUNDS BY THE PARFAIT-DISTILLATION METHOD,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5A.
W88-07807

EVALUATION OF A QUATERNARY RESIN FOR THE ISOLATION OR CONCENTRATION OF ORGANIC SUBSTANCES FROM WATER,
Envirodyne Engineers, Inc., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W88-07808

HIGH-PERFORMANCE CONCENTRATION SYSTEM FOR THE ISOLATION OF ORGANIC RESIDUES FROM WATER SUPPLIES,
Los Angeles County Sanitation Districts, Whittier, CA. San Jose Creek Water Quality Lab.
For primary bibliographic entry see Field 5A.
W88-07809

CONTINUOUS LIQUID-LIQUID EXTRACTOR FOR THE ISOLATION AND CONCENTRATION OF NONPOLAR ORGANIC COMPOUNDS FOR BIOLOGICAL TESTING IN THE PRESENCE OF HUMIC MATERIALS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5A.
W88-07810

BIOLOGICAL TESTING OF WATERBORNE ORGANIC COMPOUNDS,
Cincinnati Univ., OH. Dept. of Microbiological and Molecular Genetics.
For primary bibliographic entry see Field 5A.
W88-07811

CONCENTRATION, FRACTIONATION, AND CHARACTERIZATION OF ORGANIC MUTAGENS IN DRINKING WATER,
National Inst. of Public Health and Environmental Hygiene, Leidschendam, The Netherlands.
For primary bibliographic entry see Field 5A.
W88-07812

MUTAGENIC ACTIVITY OF VARIOUS DRINKING WATER TREATMENT LINES,
Lyonnaise des Eaux Central Lab., 38 rue du President Wilson 78239, Le Pecq, France.
For primary bibliographic entry see Field 5F.
W88-07813

NEGATIVE-ION CHEMICAL IONIZATION MASS SPECTROMETRY AND AMES MUTAGENICITY TESTS OF GRANULAR ACTIVATED CARBON TREATED WASTE WATER,
Los Angeles County Sanitation Districts, Whittier, CA. San Jose Creek Water Quality Lab.
For primary bibliographic entry see Field 5A.
W88-07814

TECHNIQUES FOR THE FRACTIONATION AND IDENTIFICATION OF MUTAGENS PRODUCED BY WATER TREATMENT CHLORINATION,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5A.
W88-07815

NEW METHODS FOR THE ISOLATION OF MUTAGENIC COMPONENTS OF ORGANIC RESIDUALS IN SLUDGES,
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
For primary bibliographic entry see Field 5A.
W88-07816

RISK ASSESSMENT AND CONTROL DECISIONS FOR PROTECTING DRINKING WATER QUALITY,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5G.
W88-07817

GUIDELINES FOR CANADIAN DRINKING WATER QUALITY,
Health and Welfare Canada, Tunney's Pasture, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5G.
W88-07818

INVESTIGATING THE TOXICOLOGY OF COMPLEX MIXTURES IN DRINKING WATERS,
Environmental Protection Agency, Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5C.
W88-07819

CONCEPTUAL EVALUATION OF 'STATIC' AND 'DYNAMIC' SEEDING MODES BASED ON RECENT ANALYSES OF ISRAELI II AND FACE 2 EXPERIMENTS,
For primary bibliographic entry see Field 3B.
W88-07867

ETHIOPIA: SOME NON-CONVENTIONAL WATER RESOURCE TECHNOLOGIES,
Research and Development in Rural Pumping Technologies, Ethiopian Water Works Construction Authority, P.O. Box 385, Addis Ababa (Ethiopia).
For primary bibliographic entry see Field 3A.
W88-07876

MEASURING AND PREDICTING SOIL EROSION,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W88-07896

MEASUREMENT OF SEDIMENT YIELDS,
Ward (Peter) and Associates, Vancouver (British Columbia).
For primary bibliographic entry see Field 2J.
W88-07898

MEASUREMENT OF BEDLOAD IN RIVERS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W88-07900

DISSOLVED LOADS AND THEIR MEASUREMENT,
Exeter Univ. (England). Dept. of Geography.
D. E. Walling,
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 111-177, 18 fig, 10 tab, 104 ref.

Descriptors: *Denudation, *Rivers, *River water, *Dissolved solids, *Suspended sediments, *Sediment erosion, *Sediment transport, Fluvial sediments, Erosion, Sampling, Mathematical models, Temporal distribution, Spatial distribution, Model studies, Sediment yield, Bicarbonates, Sulfates, Calcium, Silica, Comparison studies.

Information on dissolved loads can be of great value in evaluating rates of erosion and the relative importance of mechanical and chemical denudation processes within a drainage basin, and in providing a more comprehensive view of material transport from the continents to the oceans and the global geochemical balance. This brief overview of the nature, behavior and measurement of the dissolved loads of rivers focuses on the aggregate load, often referred to as the total dissolved solids load. Information on the mean solute composition of river waters of the world indicates that more than 80% of the dissolved load of rivers is generally made up of just four components - HCO3(-), SO4(-), Ca(2+), and SiO2. Three major controls are thought to influence the chemical composition of river water: atmospheric precipitation dominance, rock and soil dominance, and thirdly, evaporation - chemical precipitation dominance. The ratio of dissolved load to suspended sediment load varies from continent to continent. Whereas suspended sediment concentrations tend to increase markedly with increasing discharge at a measuring site, the total dissolved solids concentration will, in nearly all cases, decline and exhibit a much smaller range of variation. The dependence of concentration on discharge has prompted a number of workers to develop numerical relationships between the two variables as a means of representing this process base. Whereas suspended sediment concentrations tend to increase with increasing discharge and may rise over several orders of magnitude during flood events, dissolved solids concentrations tend to remain relatively stable through time, but generally exhibit a decrease during periods of increased flow. The impact of human activities on dissolved load dynamics is discussed. The collection and analysis of dissolved load samples is described. Spatial and temporal variations in dissolved loads and models associated with solute loads are discussed. (See also W88-07895) (Geiger-PTT)
W88-07901

MEASUREMENT OF RESERVOIR SEDIMENTATION,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
For primary bibliographic entry see Field 2J.
W88-07902

ELECTRICAL CONDUCTIVITY AND SALINE CONCENTRATIONS IN ARID LAND GROUNDWATERS,
Department of Geography, The University, Nottingham, NG7 2RD, UK.
For primary bibliographic entry see Field 2F.
W88-07914

LOCATING POTENTIAL BOREHOLE SITES IN A DISCORDANT FLOW REGIME IN THE CHALK AQUIFER AT LULWORTH USING INTEGRATED GEOPHYSICAL SURVEYS,
Hydrotechnica, Pengwern Court, High Street, Shrewsbury, SY1 1SR, UK.
For primary bibliographic entry see Field 7B.
W88-07915

LOCATING POTENTIAL BOREHOLE SITES IN A DISCORDANT FLOW REGIME IN THE CHALK AQUIFER AT LULWORTH USING INTEGRATED GEOPHYSICAL SURVEYS,
Hydrotechnica, Pengwern Court, High Street, Shrewsbury, SY1 1SR, UK.
J. F. T. Houston, J. C. Eastwood, and T. K. P. Cosgrove.
Quarterly Journal of Engineering Geology QJEGA7, Vol. 19, No. 3, p 271-282, 1986. 11 fig, 4 tab, 20 ref.

Descriptors: *Electrical studies, *Aquifers, *Groundwater movement, *Coastal aquifers, *Boreholes, *Borehole geophysics, *Flow characteristics, Coastal breaching, Chalk aquifers, Gravity studies, Resistivity, Integrated geophysical surveys, England, Water loss, Surveys, Hydrogeology, Aerial photography.

Groundwater flow in the Chalk Aquifer at Lulworth is discordant with the surface drainage pattern as a result of flow reversal consequent upon coastal breaching of the aquifer. Siting of boreholes for water supply is thus made difficult, especially since flow is confined to very narrow zones. It was felt that the chalk was being drained principally by a number of discrete water-bearing fissures or fissure zones, yet the permeability of the chalk in mass was low. An attempt was made to use surface geophysics to identify the fissure zones. An initial survey was undertaken adjacent to existing borehole sites to establish whether a relationship could be found between productive sites and unproductive ones. The results of a survey using resistivity and gravity as well as an aerial photographic study are reported. The use of geophysical techniques has enabled such zones to be identified with varying degrees of certainty. It is important not to place too much reliance on a single technique and to integrate such surveys into an overall appreciation of the evolution of the groundwater flow regime in order to obtain maximum benefits. (Brock-PTT)
W88-07915

IDENTIFICATION OF THE POSITION AND THE STEREOCHEMISTRY OF THE DOUBLE BOND IN MONOUNSATURATED FATTY ACID METHYL ESTERS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY OF DIMETHYL DISULFIDE DERIVATIVES,
Laboratoire de Physique at Chimie Mariens, Universite Pierre et Marie Curie, UA CNRS No. 353, tour 24, 4 Place Jussieu, 75252 Paris Cedex 05, France.
P. Scribe, J. Guezennec, J. Dagaut, C. Pepe, and A. Saliot.
Analytical Chemistry ANCHAM, Vol. 60, No. 9, p 928-931, May 1, 1988. 7 fig, 25 ref.

Descriptors: *Gas chromatography, *Spectrometers, *Fatty acids, *Water analysis, *Chemical analysis, *Esters, *Marine sediments, Molecular structure, Plankton, Bacteria, Isomers, Stereochemistry, Ions, Mass spectra.

A single-step derivatization procedure using dimethyl disulfide (DMDS) is described for monounsaturated fatty acid esters (MUFAME). The analysis of DMDS adducts by gas chromatography/mass spectrometry is detailed: The mass spectra (electron impact 70 eV) show molecular ions (M+) and give key fragments that permit determination of the position of the original double bond. Alkylthiolation of Z- and E-MUFAME as a specific antiaddition leads, respectively, to the threo and erythro adducts. The two isomers are well-separated by gas chromatography, permitting precise stereochemistry of the initial double bond. Nevertheless, for a complex environmental mixture of MUFAME, the stereochemical identification is restricted to the linear series. This procedure is suitable for the analysis of trace compounds at the nanogram level such as encountered in the natural environment. An application is presented for the analysis of planktonic and bacterially derived fatty acids in recent marine sediments. (Author's abstract)
W88-07950

METHOD FOR REMOTE SENSING OF PRECIPITABLE WATER VAPOR AND LIQUID IN THE ATMOSPHERE USING A 22-GHZ RADIOMETER,
Aerospace Corp., El Segundo, CA. Lab. Operations.
F. I. Shimabukuro.
Available from the National Technical Information Service, Springfield, VA. 22161, as AD-A184-204. Price codes: A02 in paper copy, A01 in microfiche. August 1987. 17 p, 3 fig, 13 ref. Aerospace Corporation Contract No. F04701-85-C-0086. Report No. SD-TR-87-38.

Descriptors: *Remote sensing, *Optical properties, *Water vapor, *Precipitation, *Radiometry, *Atmospheric physics, *Atmospheric water, Effective precipitation, Statistical methods, Atmospheric precipitation, Opacity, Light attenuation, Algorithms.

A well-known method for retrieving the precipitable water vapor (V) and liquid (L) in a nonprecipitating atmosphere utilizes a dual-channel radiometer operating at 20.6 and 31.6 GHz. Statistical retrieval algorithms are used for the determination of V and L. In this study, a somewhat different method for retrieval of the quantities V and L, using a radiometer, is described. The atmospheric opacities are determined at three frequencies (v sub 1, v sub 2, v sub 3) near the water vapor line, from emission measurements. The frequency v sub 2 is the line center, and the frequencies v sub 1 and v sub 3 are chosen such that (v sub 2) squared = 1/2((v sub 1) squared + (v sub 3) squared). From these three measurements, a differential opacity that is dependent only on the resonant part of the water vapor absorption is derived. From this quantity, estimates of V and the clear atmosphere attenuation are obtained. The cloud opacity is obtained by subtracting the clear atmosphere attenuation from the total attenuation. It is shown that the quantity V can be retrieved in light rain using this technique. (Author's abstract)
W88-07959

ANALYTICAL METHODS MANUAL FOR THE DIRECT/DELAYED RESPONSE PROJECT SOIL SURVEY,
Lockheed Engineering and Management Services Company Inc., Las Vegas, NV 89119.
For primary bibliographic entry see Field 7A.
W88-07960

IMPROVED METHOD FOR THE SIMULTANEOUS DETERMINATION OF 224-RA, 226-RA AND 228-RA IN WATER, SOILS AND SEDIMENTS,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5A.
W88-07965

IN SITU MONITORING OF ORGANICS,
Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV. Nevada Test Site.
For primary bibliographic entry see Field 7A.
W88-07977

SOIL GAS SENSING FOR DETECTION AND MAPPING OF VOLATILE ORGANICS,
Nevada Univ., Las Vegas. Environmental Research Center.
For primary bibliographic entry see Field 7A.
W88-07979

7C. Evaluation, Processing and Publication

DISINFECTION AS AN ADJUNCT TO WATER PURIFICATION,
For primary bibliographic entry see Field 5F.
W88-06833

PHYTOPLANKTON SUCCESSION IN THE SANYATI BASIN, LAKE KARIBA,
University Lake Kariba Research Station, P.O. Box 48, Kariba, Zimbabwe.
For primary bibliographic entry see Field 2H.
W88-06897

TROPHIC STATUS OF TILITSO, A HIGH ALTITUDE HIMALAYAN LAKE,
National Inst. for Environmental Studies, Yatabe (Japan).
For primary bibliographic entry see Field 2H.
W88-06898

DISTRIBUTION OF BENTHIC INVERTEBRATES IN ACID, BROWN WATER STREAMS IN THE SOUTH ISLAND OF NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-06901

WATER QUALITY STUDIES ON BUCKINGHAM CANAL (MADRAS, INDIA)--A DISCRIMINANT ANALYSIS,
Presidency Coll., Madras (India). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W88-06906

PARTICULATE ORGANIC MATTER IN A MOUNTAIN STREAM IN THE SOUTH-WESTERN CAPE, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2E.
W88-06907

BIODEGRADATION DATA EVALUATION FOR STRUCTURE/BIODEGRADABILITY RELATIONS,
Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.
For primary bibliographic entry see Field 5B.
W88-06921

PARAMETERIZATION OF PREDICTIVE FATE MODELS: A CASE STUDY,
Minnesota Mining and Mfg. Co., St. Paul. Environmental Lab.
For primary bibliographic entry see Field 5B.
W88-06926

SENSITIVITY ANALYSIS OF POPULATION GROWTH RATES ESTIMATED FROM CLADOCERAN CHRONIC TOXICITY TESTS,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5C.
W88-06928

COMPARISON OF MODELS THAT DESCRIBE THE TRANSPORT OF ORGANIC COMPOUNDS IN MACROPOROUS SOIL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-06937

DETERMINATION OF DOSE-TIME-RESPONSE RELATIONSHIPS FROM LONG-TERM ACUTE TOXICITY TEST DATA,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W88-06960

DETERMINING REGIONAL WATER QUALITY PATTERNS AND THEIR ECOLOGICAL RELATIONSHIPS,
Regional Air Pollution Control Agency, PO Box 972, Dayton, OH 45422.
T. W. McDaniel, C. T. Hunsaker, and J. J. Beauchamp.
Environmental Management EMNGDC, Vol. 11, No. 4, p 507-518, August 1987. 6 fig, 3 tab, 22 ref. US Forest Service Interagency Agreement 40-1298-82, US DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Data collection, *Watersheds, *STORET, *Water quality standards, *Regional analysis, *Discriminant analysis, Climate, Fauna, Aquatic populations, Statistical analysis, Surface-groundwater relations, Fish.

A multivariate statistical method for analyzing spatial patterns of water quality in Georgia and Kansas was tested using data in the US Environmental Protection Agency's STORET data system. Water quality data for Georgia and Kansas were organized by watersheds. Three questions were studied: (1) can distinctive regional water quality patterns be detected and predicted using only a few water quality variables, (2) are regional water quality patterns correlated with terrestrial biotic regions, and (3) are regional water quality patterns correlated with fish distributions. Using existing data, it is shown that this method can distinguish regions with water quality very different from the average conditions (as in Kansas). Data that are spatially and temporally adequate for representing large regions and for multivariate statistical analysis are available for only a few common water quality parameters. Regional climate, lithology, and biotic regimes all have the potential to affect water quality, and terrestrial biotic regions and fish distributions do compare with regional water quality patterns, especially in a state like Georgia, where watershed characteristics are diverse. Thus, identifiable relationships between watershed characteristics and water quality should allow the development of an integrated land-aquatic classification system that would be a valuable tool for resource management. It is concluded that because geographical distributions of species may be limited by zoogeographic and environmental factors, the recognition of patterns in fish distributions that correlate with regional water quality patterns could influence management strategies and aid regional assessments. (Author's abstract)
W88-06967

STREAM CORRIDOR MANAGEMENT IN THE PACIFIC NORTHWEST: I. DETERMINATION OF STREAM-CORRIDOR WIDTHS,
Washington State Univ., Pullman. Program in Environmental Science and Regional Planning.
For primary bibliographic entry see Field 4A.
W88-06969

INDICES OF HYDROLOGICAL DROUGHT IN ISRAEL,
Israel Hydrological Service, P.O. Box 6381, Jerusalem, Israel.
For primary bibliographic entry see Field 2A.
W88-07114

SUBSTRATE SPECIFICITY OF HETEROTROPHIC BACTERIA IN THE WATER AND SEDIMENT OF A CARP CULTURE POND,
Department of Fisheries, College of Agriculture and Veterinary Medicine, Nihon University, Shimouma 3, Setagaya, Tokyo 154 (Japan).
For primary bibliographic entry see Field 2H.
W88-07115

ESTIMATION OF BOD PARAMETERS BY AN INTEGRAL METHOD,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. R. Bowers, R. Robinson, and A. D. Koussis.
Environmental Technology Letters ETLEDB, Vol. 8, No. 7, p 317-326, July 1987. 2 fig, 4 tab, 21 ref, append.

Descriptors: *Biochemical oxygen demand, *Water quality, *Mathematical Studies, *Model Studies, *Reed-Theriault, Wastewater treatment, Least squares, Differential equations, Estimating equations, Integral method, United States.

A new method for estimating the ultimate BOD and the first-order BOD rate coefficient has been developed. The method uses the integral of the BOD-exerted curve rather than its slope, and is therefore efficient and robust. The accuracy is superior to that of the traditional techniques, producing results comparable to the Reed-Theriault non-linear least squares technique. In addition, the method has no restriction on the range of input data and handles lag periods in BOD exertion without difficulty. (Author's abstract)
W88-07137

ROLE OF QUALITY ASSURANCE IN NATIONAL ACID RAIN RESEARCH IN THE UNITED STATES,
Northrop Services, Inc., Research Triangle Park, NC.
R. A. Mickler, and S.A. Medlarz.
Environmental Technology Letters ETLEDB, Vol. 8, No. 10, p 459-466, October 1987. 3 ref. EPA/600/X-86/193ABCD.

Descriptors: *Quality assurance, *Acid rain, *Air pollution effects, *Water pollution sources, *United States, *National Acid Rain Precipitation Assessment Programs, *Forest Response Program, Quality control, Precipitation, Meteorology, Forests, Statistical methods.

In response to inconclusive scientific evidence indicating that acidic deposition is affecting the growth of forests in the United States, the Environmental Protection Agency and the Forest Service have established a joint research program, the Forest Response Program. Quality assurance principles have been implemented within the program to provide data of known and documented quality using environmental measurement techniques in a state of statistical control. The Forest Response Program and the approach for assessing data quality in biological research, based on quality control and quality assurance techniques are described. (Author's abstract)
W88-07149

MODELING NUTRIENT BEHAVIOR IN WETLANDS,

Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W88-07164

CORRELATION BETWEEN SPATIALLY VARIABLE SOIL MOISTURE CONTENT AND SOIL TEMPERATURE,
Louisiana State Univ., Baton Rouge. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W88-07170

VARIABILITY OF SATURATED HYDRAULIC CONDUCTIVITY IN A GLOSSAQUIC HAPLUDALF WITH MACROPORES,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2F.
W88-07171

REPRESENTATION OF FLOWS TO PARTIALLY PENETRATING RIVERS FROM LAYERED AND ANISOTROPIC AQUIFERS,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 2F.
W88-07196

STATISTICAL APPROACH OF THE ARIDIFICATION PROCESS IN WESTERN AFRICA (APPROCHE STATISTIQUE DE L'ARIDIFICATION DE L'AFRIQUE D L'OUEST),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France).
For primary bibliographic entry see Field 2B.
W88-07200

DESIGN OF REVERSE OSMOSIS PROCESS,
Department of Material Science and Chemical Engineering, Yokohama National University, Yokohama, Japan.
For primary bibliographic entry see Field 3A.
W88-07236

RELATIONSHIP BETWEEN ANNUAL RUNOFF AND WATERSHED AREA FOR THE EASTERN UNITED STATES,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2E.
W88-07275

PATTERNS AND TRENDS IN IRRIGATION EFFICIENCY,
Geography Department, University of New Mexico, Bandelier West, Room 118, Albuquerque, New Mexico 87131.
For primary bibliographic entry see Field 3F.
W88-07278

PLANNING OF URBAN BEST MANAGEMENT PRACTICES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W88-07285

EFFECT OF MONITORING WELL STORAGE ON THE SHAPE OF BREAKTHROUGH CURVES - A THOEORETICAL STUDY,
Department of Environmental Sciences, Oregon Graduate Center, 19600 NW von Neumann Drive, Beaverton, OR 97006-1999.
C. D. Palmer.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 45-57, January 15, 1988. 10 fig, 13 ref. USGS Grant No. 14-08-0001-AO-410.

Descriptors: *Aquifer characteristics, *Path of pollutants, *Monitoring wells, *Water storage, *Breakthrough curves, *Porous media, Boreholes, Porosity, Tracers, Mathematical studies.

The water stored in the screened interval of monitoring wells can have a significant effect on concentration breakthrough curves. An analytical solution that accounts for this stored water was derived assuming there is complete mixing within the screened interval of the monitoring well. A study of theoretical breakthrough curves based on the derived equation demonstrated that estimates of the time of arrival, as judged by the center of mass of the breakthrough curve, and the variance and skewness of the concentration distribution in time can be in error compared to those for the tracer concentration in the porous medium. Errors in the calculated time of arrival can be as great as 200%. Errors in the calculation of variance and skewness can reach factors of 100 or more. These errors will increase with decreasing distance from the source, porosity of the medium, cross-sectional area to volume ratio of the screened interval of the monitoring well, variance of the concentration input into the screen, and degree to which flow lines are distorted by the presence of the monitoring well and its associated sand pack. If the porosity of the formation, the borehole factor, and the dimensions of the monitoring well are known, the concentration breakthrough for the porous medium can be calculated from the concentration breakthrough curve for the monitoring well. These calculations will improve interpretation of tracer test data by eliminating effects that are the result of the presence of the borehole. (Author's abstract)
W88-07297

TIME AND FREQUENCY RESPONSE OF TRACER EXPERIMENTS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
C. J. Duffy, and S. Al-Hassan.
Journal of Hydrology JHYDA7, Vol. 97, No. 1/2, p 59-73, January 15, 1988. 6 fig, 2 tab, 15 ref. NSF Grant CEE83-07982.

Descriptors: *Disperson, *Advection, *Groundwater movement, *Path of pollutants, *Mathematical analysis, *Tracers, *Data interpretation, Fourier analysis, Soil water, Diffusivity.

Two distinctly different approaches to the interpretation of advective and dispersive transport characteristics of an intermediate scale (0-6 m) tracer experiment were examined. The first, or time domain method, is based on a direct analysis of the tracer breakthrough via the widely used moment method. The second, or frequency domain method, is based on a comparison of the Fourier transform of the tracer breakthrough and its theoretical counterpart, the frequency response function. The experiment was conducted at Los Alamos National Laboratory to evaluate the performance of crushed Bandelier turf as a medium for waste disposal. Both methods provide satisfactory estimates of the mean advective transport component of the experiment for both conservative and nonconservative tracer. For the sampling ports closest to the source (0-2 m), the moment method produces much larger estimates of the dispersivity than the frequency response method. This difference is attributed to a buildup of errors in the estimation of higher moments, resulting from local variations in the tracer and fluid migration rates within this zone. In the lower part of the caisson (> 2 m), the tracer breakthrough is smoother, and both methods provide similar and smaller dispersivity estimates. Overall the frequency domain approach is less sensitive to random variations in the breakthrough response. This idea is illustrated with an example from optimal filtering theory. (Author's abstract)
W88-07298

FORECAST OF CHANGES IN PIEZOMETRIC LEVELS BY A LUMPED HYDROLOGICAL MODEL,
Water and Environmental Department, Bureau of Geological and Mining Researches, Avenue de Concyr, B.P. 6009, 45060 Orleans Cedex 2 (France).
For primary bibliographic entry see Field 2F.
W88-07302

FIELD STUDY OF SEEPAGE AND MIGRATION PROCESSES IN FISSURED-POROUS ROCKS,
Department of Hydrogeology, Mining Institute, 22-linga Leningrad V.O. (U.S.S.R.).
For primary bibliographic entry see Field 5B.
W88-07303

EVALUATION OF A SNOWMELT MODEL IN A BOREAL FOREST, (EVALUATION D'UN MODELE DE FONTE NIVALE EN FORET BOREALE),
Laboratoire d'Hydrologie Forestiere, Departement des Sciences Forestieres, Faculte de Foresterie et de Geodesie, Universite Laval, 0830 Pavillon Vachon, sainte-Foy, Que. G1K 7P4 (Canada).
For primary bibliographic entry see Field 2C.
W88-07304

MODELING OF WATER BALANCE, CRACKING AND SUBSIDENCE OF CLAY SOILS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W88-07306

SUMMARY OF FLOOD-FREQUENCY ANALYSIS IN THE UNITED STATES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W88-07385

USE OF HISTORICAL RECORDS IN FLOOD FREQUENCY ANALYSIS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W88-07396

PROBLEMS IN STATISTICAL TREATMENT OF FLOOD SERIES,
Anhui Water Resources Research Institute, 110 Zhihuai Road, Bengbu, Anhui, Province (P.R. of China).
For primary bibliographic entry see Field 2E.
W88-07397

PROBABILITY PLOTTING POSITION FORMULAS FOR FLOOD RECORDS WITH HISTORICAL INFORMATION,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W88-07398

DETERMINATION OF CONFIDENCE INTERVALS FOR DESIGN FLOODS,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
For primary bibliographic entry see Field 2E.
W88-07399

USE OF HISTORICAL INFORMATION IN A MAXIMUM-LIKELIHOOD FRAMEWORK,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W88-07400

DISCUSSION ON THE EXTRAPOLATION OF HYDROLOGIC SERIES,
Tanjin Design Institute, Ministry of Water Resources and Electric Power, Tianjin (P.R. of China).
J. Zhu.
Journal of Hydrology JHYDA7, Vol. 96, No. 1-4, p 225-235, December 1987. 3 tab, 7 ref.

Descriptors: *Hydrologic data, *Statistical methods, *Variance, *Correlation coefficient, *Statistics, Estimating, Time series analysis.

This paper presents some preliminary discussions on the conditions for increasing the accuracy in estimating the variance of hydrological elements by means of statistical tests based on a theoretical bivariate normally distributed population when the series is extended by correlation. A comparison is

made of the results obtained from several methods for adjusting variances. In order to increase the practical usefulness of the results, sample correlation coefficients are used as the main indices in the tests. The results show, first, that the sample correlation coefficient has to exceed a certain critical value r(min) to improve the accuracy of the variance estimated by extending a hydrological series. The critical value r(min) varies according to the magnitude of the variances and the length of the extended series. Under typical conditions, an increase in the accuracy of estimating variance is obtained with extended series only when the sample correlation coefficient exceeds 0.8. Second, from the several methods of adjusting variance, it is apparent that the variance computed by combining the values obtained by extending the series and the observed data is a biased estimate with poor efficiency. This method can only be used under certain limited conditions. The estimates obtained by the method outlined have proven to be essentially unbiased. (Author's abstract)
W88-07401

EFFECT OF DISCHARGE MEASUREMENT ERROR IN FLOOD FREQUENCY ANALYSIS,
East China Technical Univ. of Water Resources, Nanjing. Dept. of Hydrology.
For primary bibliographic entry see Field 2E.
W88-07402

REGIONAL REGRESSION OF FLOOD CHARACTERISTICS EMPLOYING HISTORICAL INFORMATION,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W88-07403

STUDY OF DESIGN STORMS IN CHINA,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
For primary bibliographic entry see Field 2B.
W88-07405

PROBLEMS WITH OUTLIER TEST METHODS IN FLOOD FREQUENCY ANALYSIS,
Nanjing Research Institute of Hydrology and Water Resources, Nanjing, Jiangsu Province (P.R. of China).
For primary bibliographic entry see Field 2E.
W88-07413

SSSP: SIMULATION OF SINGLE-SLUDGE PROCESSES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5D.
W88-07420

EVALUATION OF THE EQUILIBRIUM CALCULATIONS WITHIN ACIDIFICATION MODELS: THE EFFECT OF UNCERTAINTY IN MEASURED CHEMICAL COMPONENTS,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W88-07443

EFFECT OF INTERSITE DEPENDENCE ON REGIONAL FLOOD FREQUENCY ANALYSIS,
IBM Research Div., Yorktown Heights, NY.
For primary bibliographic entry see Field 2E.
W88-07449

WIND SET-UP ERROR IN MEAN LAKE LEVELS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W88-07512

PARAMETER ESTIMATION MODEL FOR UNGAGED STREAMFLOWS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-07513

SIMULATION OF WATER DISCHARGE RATES FROM A CLAY-TILL SOIL OVER A TEN YEAR PERIOD,
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
For primary bibliographic entry see Field 2G.
W88-07514

SOME NEW PERSPECTIVES ON THE PROBABILISTIC MODELING OF FLOODS,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-07518

ESTIMATION OF VOLUME OF SNOWMELT FROM TEMPERATURE OF SNOW LINE AND RESIDUAL SNOW AMOUNT,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-07523

SIMPLE MATHEMATICAL MODEL OF A COMPLEX HYDROLOGIC SYSTEM - OKAVANGO SWAMP, BOTSWANA,
For primary bibliographic entry see Field 2A.
W88-07524

NITRATE NITROGEN IN THE BELGIAN COURSE OF THE MEUSE RIVER - FATE OF THE CONCENTRATIONS AND ORIGINS OF THE INPUTS,
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. of Analytical Chemistry and Mass Spectrometry.
For primary bibliographic entry see Field 5B.
W88-07527

USE OF CROSS-CORRELATION ANALYSIS IN STUDIES OF PATTERNS OF RAINFALL VARIABILITY,
For primary bibliographic entry see Field 2B.
W88-07529

STORM TRACKING USING RAIN GAUGE DATA,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2B.
W88-07530

IDENTIFICATION OF PARAMETERS IN SEMICONFINED AQUIFERS,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-07532

IMPROVED FLOOD ROUTING BY ARMA MODELLING AND THE KALMAN FILTER TECHNIQUE,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2E.
W88-07533

COMMUNITY DEGRADATION INDEX: A NEW METHOD FOR ASSESSING THE DETERIORATION OF AQUATIC HABITATS,
Estuaries and Coastal Processes Division, The National Institute for Water Research, P.O. Box 17001, Congella 4036, Republic of South Africa.
For primary bibliographic entry see Field 5C.
W88-07540

PRECIPITATION AND STREAMWATER CHEMISTRY IN A SUBARCTIC SCOTTISH CATCHMENT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W88-07561

COMPARISON OF VARIOUS METHODS TO SCALE SOIL HYDRAULIC PROPERTIES,
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
For primary bibliographic entry see Field 2G.
W88-07562

COMPARISON OF TWO RECENT MODELS FOR ESTIMATING ACTUAL EVAPOTRANSPIRATION USING ONLY REGULARLY RECORDED DATA,
Department of Environmental Resources, Cook College, Rutgers University, New Brunswick, NJ 08903 (U.S.A.).
For primary bibliographic entry see Field 2D.
W88-07563

ANALYSIS OF DRAWDOWN IN THE COUNTRY ROCK OF COMPOSITE DIKE AQUIFERS,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 2F.
W88-07578

LONG RANGE STREAMFLOW AND WORLD CONTINENTAL RUNOFF FLUCTUATIONS SINCE THE BEGINNING OF THIS CENTURY,
Centre de Sedimentologie et de Geochimie de la Surface, Institut de Geologie, 1 rue Blessig, 67084 Strasbourg Cedex (France).
For primary bibliographic entry see Field 2A.
W88-07582

RAINFALL VARIATIONS IN THE GALILEE (ISRAEL): I. VARIATIONS IN THE SPATIAL DISTRIBUTION IN THE PERIODS 1931-1960, AND 1951-1980,
Haifa Univ. (Israel). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W88-07584

OBJECTIVE ANALYSIS OF MONTHLY CLIMATOLOGICAL FIELDS OF TEMPERATURE, SUNSHINE, RAINFALL PERCENTAGE AND RAINFALL AMOUNT,
Meteorological Service, Glasnevin Hill, Dublin 9, Ireland.
For primary bibliographic entry see Field 2B.
W88-07627

SYNOPTIC CLIMATOLOGICAL ANALYSIS OF RAINFALL VARIABILITY IN SOUTH-EASTERN AUSTRALIA,
Dept. of Geography and Cainozoic Research Unit, Monash Univ., Clayton, Victoria 3168, Australia.
For primary bibliographic entry see Field 2B.
W88-07629

CHANGES IN PRECIPITATION CONDITIONS IN THE WESTERN MEDITERRANEAN OVER THE LAST CENTURY,
Inst. of Meteorology and Climatology, Aristotelian Univ. of Thessaloniki, Greece.
For primary bibliographic entry see Field 2B.
W88-07630

RETROFITS/MANAGEMENT MEET TOUGH WATER QUALITY CONSTRAINTS,
For primary bibliographic entry see Field 5F.
W88-07676

ESTIMATION OF PARAMETERS FOR THE PHILIP TWO-TERM INFILTRATION EQUATION APPLIED TO FIELD SOIL EXPERIMENTS,

Division of Soils, Commonwealth Scientific and Industrial Organization, P.M.B., P.O. Aitkenvale, Qld 4814.
For primary bibliographic entry see Field 2G.
W88-07701

MODIFIED RUNOFF CURVE NUMBERS FOR BARE CRUST-FORMING SANDY SOILS,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2E.
W88-07704

WATER QUALITY AND BIOLOGICAL SURVEY OF THE WEST BRANCH SUSQUEHANNA RIVER,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07714

SUMMARY OF DATA ON STREAM REACHES AND MAPPING COVERAGE USED FOR FLOOD INSURANCE STUDIES.
Susquehanna River Basin Commission, Harrisburg, PA. Div. of Planning and Operation.
For primary bibliographic entry see Field 6F.
W88-07716

WATER QUALITY AND BIOLOGICAL SURVEY OF THE SUSQUEHANNA RIVER BASIN FROM WAVERLY, NEW YORK TO SUNBURY, PENNSYLVANIA,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07719

WATER QUALITY AND BIOLOGICAL SURVEY OF THE JUNIATA RIVER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07720

WATER QUALITY AND BIOLOGICAL SURVEY OF THE CHEMUNG RIVER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07722

WATER QUALITY AND BIOLOGICAL SURVEY OF THE EASTERN HEADWATER SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07723

WATER QUALITY AND BIOLOGICAL SURVEY OF THE LOWER SUSQUEHANNA SUBBASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07724

WATER USE DATA IN THE SUSQUEHANNA BASIN, PART I: STATUS OF DATA COLLECTION.
Susquehanna River Basin Commission, Harrisburg, PA. Planning and Operations Div.
Publication No. 75. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. February 1982. 17 p, 1 fig, 6 tab.

Descriptors: *Water use, *Data acquisition, *Susquehanna River, *Pennsylvania, *New York, *Data collections, Computers, Data storage and acquisition, Pennsylvania, Maryland, National Water use Data Program.

To utilize available data on water use effectively, it is necessary to make appropriate administrative arrangements to acquire the data. In order to facilitate exchange of data as well as use of the data for Susquehanna River Basin Commission studies and project reviews, it is the opinion of the staff that the data should be computerized. Staff is promoting discussions to determine the responsibility for computerizing the various data files. The U.S. Geopogical Survey National Water Use Data Program is a nationwide effort to collect and computerize water use information. All of the states in the Susquehanna River basin are participating in this program with funding by USGS. The individual state data files are described. The New York Department of Health (DOH) is concerned with water use from the standpoint of public health. They define a public water supply system as one which operates more than 60 days/yr and either serves more than 25 people or has more than 5 service connections, and provides treatment of water. Certain water use data are collected routinely as part of their monitoring of the quality of water supplied by public water supply systems. Data forms have been developed to extract the necessary data for systems. Data forms have been developed to extract the necessary data for input ot the USGS system. The New York Department of Environmental Conservation (DEC) is the official cooperator in the USGS program. Their water use data program is designed to provide input to the USGS program. Public water supply data from the DOH has been used as input to the USGS data system. Based on the permit data file, it would be possible to determine sources used and water allocation for public water suppliers if the name of the supplier is known. The Pennsylvania Department of Environmental Resources (DER) has been collecting water use information since about 1970. The data from the questionnaires has been computerized by DER but only water use data from the most recent questionnaire in any category is retained and available from the computerized data system. Maryland water use data and the Susquehanna River Basin Commission water use data are also presented. (Lantz-PTT)
W88-07725

SUMMARY OF WATER QUALITY DATA FROM THE CHEMUNG AND SUSQUEHANNA RIVERS NEAR THE NEW YORK - PENNSYLVANIA STATELINE,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-07726

SPECIAL GROUND-WATER STUDY: EXECUTIVE SUMMARY,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 2F.
W88-07728

CHESAPEAKE BAY DATA BASE: DOCUMENTATION OF HISTORICAL DATA IN THE LOWER SUSQUEHANNA RIVER BASIN,
Susquehanna River Basin Commission, Harrisburg, PA.
R. E. Edwards.
Publication No. 106. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. August 1986. 167 p, 2 tab, 4 append. NOAA Grant No. NA-83-AA-D-CZ048.

Descriptors: *Data storage and retrieval, *Chesapeake Bay Data Base, *Water quality, *Susquehanna River, Data collections, Monitoring, Networks, Management planning, Historical data.

In order to effectively manage the resources of the Chesapeake Bay as well as the implementation of pollution controls in the Chesapeake Bay drainage basin, the Susquehanna River Basin Commission (SRBC) has placed historical water quality data and corresponding project documentation into the EPA's Chesapeake Bay Data Base. The data collected and stored have been generated from special studies, general surveys, and monitoring networks in the lower Susquehanna River Basin. These data will be useful in monitoring baseline trends within the lower Susquehanna River Basin. (Lantz-PTT)
W88-07736

WATER USE DATA IN THE SUSQUEHANNA BASIN, PART II: WATER USE INVENTORY IN NEW YORK,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6D.
W88-07738

HYDROLOGIC ENGINEERING CENTER'S ACTIVITIES IN WATERSHED MODELING,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2A.
W88-07740

STATISTICAL STUDY OF THE NORTH DAKOTA CLOUD MODIFICATION PROJECT,
Oklahoma Univ., Norman. Oklahoma Climatological Survey.
For primary bibliographic entry see Field 3B.
W88-07741

NATIONAL SURFACE WATER SURVEY: WESTERN LAKE SURVEY-PHASE I, DATA BASE DICTIONARY,
Science Applications International Corp., Oak Ridge, TN.
For primary bibliographic entry see Field 2H.
W88-07760

MONTANA RIVERS STUDY DATA MANAGEMENT SYSTEM: USER'S MANUAL.
Morrison-Maierle, Inc., Billings, MT.
Available form the National Technical Information Service, Springfield, VA. 22161, as DE87-011163. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/BP--830, Version 1.0, March 1987. 59 p, 24 fig, 4 append.

Descriptors: *Databases, *Montana, *Data management, *Computer programs, Rivers, Data storage and retrieval, Data acquisition, Manuals.

The User's Manual is designed to aid the use of the Montana Rivers Study data management system. The system is written in dBase III Plus. The Montana Rivers Study database is a dynamic system and will be continuously updated. However, it is crucial that any updating or changes in data be centrally coordinated. Throughout this manual, examples using actual data from the database illustrate the use and the power of the system. Because of the very large size of some of the data files, the programs may seem relatively slow when first compared with other current software systems. The data comprising the Montana Rivers Study is contained in several very large files. Some of the routines use all of these files to gather the information requested. This manual is not intended to be a short course in dBase III Plus, but is designed only to be a tool to facilitate the use of the Montana Rivers Study Data Management System. (Lantz-PTT)
W88-07775

GWPATH: INTERACTIVE GROUND-WATER FLOW PATH ANALYSIS,
Illinois State Water Survey Div., Champaign.
J. M. Shafer.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227088. Price codes: A04 in paper copy, A01 in microfiche. Bulletin 69, State of Illinois Department of Energy and Natural Resources. Report No. ISWS/BUL-69/87, 1987. 42 p, 21 fig, append.

Descriptors: *Groundwater movement, *Computer programs, *GWPATH, *Model studies, Groundwater, Computers, Hydrologic models, Permeability coefficient, Porosity, Hydraulic head, Geohydrology, Flow profiles.

GWPATH is an interactive software package for estimating horizontal fluid pathlines and travel times in fully saturated groundwater domains. GWPATH was developed for the IBM PC-AT, and compatibles, microcomputing environment and takes full advantage of interactive graphical display. The code features interactive data entry, forward and reverse pathline tracking, time-related capture zone analysis, multiple pathline capture detection mechanisms, multiple configurations for pathline starting locations, and variable time stepping. GWPATH is applicable to inhomogeneous, anisotropic complex flow domains. Data requirements include definition of the groundwater flow domain configuration, a hydraulic head distribution, hydraulic conductivity, and effective porosity. Both hardcopy printable output and six-pen plotter output are generated by GWPATH. (Author's abstract)
W88-07780

COLOR INFRARED VIDEO MAPPING OF UPLAND AND WETLAND COMMUNITIES,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7B.
W88-07782

CALIBRATION AND TESTING OF NUTRIENT AND PESTICIDE TRANSPORT MODELS,
GKY and Associates, Inc., Springfield, VA.
For primary bibliographic entry see Field 5B.
W88-07834

DROUGHT CONDITIONS: STAFF SUMMARY,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W88-07845

DROUGHT CONDITIONS: STAFF SUMMARY,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W88-07846

SEDIMENT YIELD MODELLING,
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 2J.
W88-07899

RISK ASSESSMENT OF SOIL CONTAMINATION CRITERIA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5C.
W88-07957

EROSION-PRODUCTIVITY ECONOMICS MODEL: A USER'S GUIDE,
Economic Research Service, Temple, TX. Resources and Technology Div.
For primary bibliographic entry see Field 2J.
W88-07967

8. ENGINEERING WORKS

8A. Structures

POTENTIAL GEOLOGIC HAZARDS NEAR THE THISTLE LANDSLIDE, UTAH COUNTY, UTAH,
US Geological Survey, Federal Center, Denver, CO 80225.
For primary bibliographic entry see Field 8E.
W88-06849

ENERGY LOSSES AND FLOATING BREAKWATER RESPONSE,
Dept. of Hydrology and Environmental Engineering, Univ. of Pavia, 27100 Pavia, Italy.
For primary bibliographic entry see Field 8B.
W88-06852

DIVERSION CONDUIT AND LOW-LEVEL OUTLET FOR PUNCHINA DAM,
Integral S. A., Apartado Aereo 3036, Medellin, Colombia.
F. Villegas, and O. Mejia.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 4, p 396-408, April 1988. 9 fig, 6 ref.

Descriptors: *Conduits, *Hydraulic design, *Dam design, *Dam construction.

The design, construction, and performance of a cut-and-cover diversion conduit, which required applying some unconventional design concepts is described. The reasons for selecting a cut-and-cover conduit instead of a tunnel are presented. The hydrological, hydraulic, and structural criteria for design of the conduit are explained, and the construction of the conduit and the problems that occurred during river diversion are described. Performance of the structure confirmed the validity of the hydraulic and structural assumption made during the design. (Sand-PTT)
W88-07431

GRAVITY-AFFECTED POTENTIAL FLOWS PAST SPILLWAY FLIP BUCKETS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 8B.
W88-07432

OPTIMAL DEWATERING SCHEMES IN THE FOUNDATION DESIGN OF AN ELECTRONUCLEAR PLANT,
ENEL-CRIS, Mestre-Venezia, Italy.
G. Galeati, and G. Gambolati.
Water Resources Research WRERAO, Vol. 24, No. 4, p 541-552, April 1988. 6 fig, 2 tab, 37 ref.

Descriptors: *Groundwater movement, *Model studies, *Design criteria, *Design standards, *Nuclear powerplants, *Foundations, *Dewatering, Finite element method, Economic aspects, Aquifers, Injection, Unconfined aquifers.

A three-dimensional finite element model combined with an optimization approach based on linear mixed integer programming was developed and used to assist in the design of the dewatering system for the electronuclear plant to be built by the Italian Electric Agency (ENEL) in Trino Vercellese, northwestern Italy. The foundations site is encompassed by a 25- to 35-m deep plastic wall to protect the unconfined aquifer from the significant water table lowering required by the construction project. To reduce further the propagation of the depression cone a large amount of the water pumped out is reinjected through 'ad hoc' recharge ditches. The finite element optimization model includes both the natural and the artificial constraints and provides several optimal withdrawal strategies for the dewatering system design concerning the distribution of the abstraction wells and the corresponding pumping rates. Physical and economical objective functions were explored and the related solutions are discussed. (Author's abstract)
W88-07444

YACYRETA BI-NATIONAL HYDROELECTRIC DEVELOPMENT,
Entidat Binacional Yacyreta; E. Madero 942 - 1106 Buenos Aires, Argentina.
R. Cappucci, F. L. Bojanovich, and E. G. Aisiks.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 21-25, April 1988. 7 fig, 2 tab.

Descriptors: *Powerplants, *Electric powerplants, *Dam construction, *Hydroelectric power, *Dam design, *Design standards, *Yacyreta, *Dams, *Argentina, *Paraguay, Civil engineering, Developing countries, Hydrology, Water resources development, Construction.

The Yacyreta hydroelectric project is one of the world's largest hydroelectric developments under construction. It is on the Parana river, between Argentina and Paraguay, and will have a 69.6 km-long dam, a 2700 MW powerplant, a navigation lock, fish-passage facilities and irrigation outlets on both river banks. Yacyreta dam will probably be the longest dam in the world when completed in 1992. The project represents a major step in the development of the substantial hydroelectric resources of Argentina and Paraguay. After several delays and a slow start, it appears that the Yacyreta project is heading steadily towards its scheduled completion date in 1996. (Alexander-PTT)
W88-07454

HYDROPOWER DEVELOPMENT ON THE HUALLAGA RIVER IN PERU,
Shawinigan Engineering Co. Ltd., Montreal (Quebec). Hydro-Electric Div.
J. R. Linard.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 28-32, April 1988. 6 fig, 1 tab.

Descriptors: *Dam construction, *Hydroelectric power, *Dam design, *Dams, *Chagila, *Peru, Civil engineering, Developing countries, Hydrology, Water resources development, Design standards, Construction, Reservoir silting.

The only major hydroelectric development planned for Peru for the remainder of this century is the 420 MW Chagila project on the Huallaga River in the Central Andes. The key features of the project, as well as a possible complementary scheme that would increase the installed capacity in the region to more than 1300 MW in a four-stage development, are described. Despite possible reservoir sedimentation problems resulting from the limited storage available at the dam site, the Chagila hydroelectric scheme, with 420 MW installed capacity and annual energy production of 2840 GWh, has been found to be technically and economically feasible. By developing the hydroelectric resources of the project area further, an additional capacity of 900 MW, producing some 6000 GWh annually, could be installed in stages to meet growth in demand. (Alexander-PTT)
W88-07455

HYDRO IN BRAZIL: RESOLVING ENVIRONMENTAL CONFLICTS,
Eletrosul, PO Box D-17, 88048 Florianopolis, Santa Catarina, Brazil.
For primary bibliographic entry see Field 8C.
W88-07456

DESIGN AND OPERATION OF THE COLBUN SPILLWAY AND LOW-LEVEL OUTLET,
Empresa Nacional de Electricidad SA, Casilla 1392, Santiago, Chile.
L. Alvardo, A. Mery, and N. L. S. Pinto.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 38-42, April 1988. 8 fig, 2 tab, 3 ref.

Descriptors: *Dam construction, *Hydroelectric power, *Design standards, *Design criteria, *Hydraulic equipment, *Colbun spillway, *Cavitation, *Chili, Civil engineering, Developing countries, Water resources development, Aeration.

The important role of aeration devices in preventing cavitation erosion in hydraulic structures with high velocity flows, such as spillways and low-level outlets is stressed. With reference to the Colbun scheme in Chile, how low-level outlets can be designed safely and economically incorporating aeration devices. The steel lining of the conduits can be restricted to the gate compared with conventional design practice, where long steel-lined sections are required. The excellent operation of the spillway and of the low-level outlet at Colbun dam has demonstrated the effectiveness of air entrainment to avoid cavitation in high velocity flows. The continual operation of the low-level outlet over a period of 324 days, with velocities above 40 m/s for 290 days, with no damage whatsoever, the effectiveness of the design. (Alexander-PTT)
W88-07457

120 MW URUGUA-I SCHEME INCORPORATES ARGENTINA'S FIRST R.R.C. DAM,
Tamrock, PO Box 279, SF-33101 Tampere, Finland.
A. Gardiner.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 43-44, April 1988.

Descriptors: *Hydroelectric power, *Water resources development, *Dam construction, *Powerplants, *Electric powerplants, *Urugua-i, *Argentina, *Tunnelling, Developing countries, Hydrology, Civil engineering, Construction.

Although 39% of Argentina's electricity production is from hydroelectric power, a vast amount of the country's exploitable hydro potential remains to be developed. As much as 75% of the country's requirements could be met by hydropower by the year 2000. This article focuses on the civil works, now under construction, for the medium-scale Urugua-i scheme, which will make a valuable contribution to Argentina's hydro development program. To excavate this tunnel, Tamrock has supplied a two-boom jumbo which is mounted on a Brazilian-made Terex hauler. A total of 15 of these 22 t capacity haulers are being used together with a fleet of 13 Caterpillar front-end loaders for the muck-shifting operation. The main problem in the tunnelling has been an abrasive and highly fractured microcrystalline basalt in the upper half of the tunnel section, which requires considerable reinforcement in places, and also reduces the drill bit life by half. Below this layer the basalt is more competent. On average the jumbo has drilled 96 m/h, the total tunnelling required will be 45,000 m. Tunnelling started in May 1987, and the contractor has reported that the construction plant has performed well, with almost 100% availability of the jumbo. A typical round consists of 75-80 holes of 45 mm diameter, and one 89 mm cut hole, all drilled with Kometa steels. Pull averages 3-3.5 m, and the whole round takes roughly 4 h to drill, blast and muck. (Alexander-PTT)
W88-07458

COORDINATED EFFORTS SOLVE BACKWATER PROBLEM,
Bureau of Engineers, Milwaukee, Wisconsin.
For primary bibliographic entry see Field 5D.
W88-07484

SHORT-TERM SLIPPING OF A SHALLOW EXCAVATION IN GAULT CLAY,
R. H. G. Parry.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 84, Pt. 1, p 337-353, April 1988. 16 fig, 4 tab, 7 ref.

Descriptors: *Flod control, *Clays, *Channel reconstruction, *Cluverts, *Slips, *Slip zones, *Excavation, On-site investigations, On-site tests, Expansive clays, Aeration zone, Piles, Abutments, Construction methods, Pressure distribution.

A geotechnical investigation was conducted of slips occurring in an excavated channel in stiff gault clay, with a maximum depth of 3.2 m and gradient of side slopes of 1:1. Investigation of slipped zones consisted of driving in pegs to allow vertical and horizontal movements to be measured and hand trenching into slips at two sections to locate the slip zone, to take samples and to measure field vane strengths within, above and below the slip zone. The soil in the slip zone was made up of a matrix of very soft clay with pieces of harder clay in it. Slipping occurred during excavation and at interals over the next four years, when the channel was reconstructed. For reconstruction, culverting and sheet piling were considered but both were ultimately discarded because of various problems. Instead, a wall scheme was adopted. Lateral pressures on the walls were calculated by the designers on the basis of earth pressure at rest, with a coefficient of unity. The sloping ground surface behind the wall was allowed for by assuming a uniform surcharge equivalent to 1.0 m height of soil above the top of the wall. This gave earth pressures 33% higher than a Coulomb wedge analysis adopting phi' = 22 degrees, c' = 0. (Friedmann-PTT)
W88-07490

SEEPAGE UNDERNEATH BARRAGES WITH DOWNSTREAM SUBSIDIARY WEIRS,
Alexandria Univ. (Egypt). Faculty of Engineering.
For primary bibliographic entry see Field 4A.
W88-07491

MATHEMATICAL MODEL FOR LEAK LOCATION IN PIPELINES,
Department of Mechanical Engineering, Cairo University.
For primary bibliographic entry see Field 5G.
W88-07494

REDEVELOPMENT OF AN ABANDONED SMALL HYDRO PROJECT,
Hendon Engineering Assoc., Inc., P.O. Box 20348, Birmingham, AL 35216.
R. S. Woodruff.
Journal of Energy Engineering JFEED9, Vol. 114, No. 1, p 26-41, April 1988. 8 fig, append.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Feasibility studies, Licensing, Long-term planning, Project planning, Construction, Electrical power, Powerplants, Diversion, Wastewater treatment.

There were innumerable small hydroelectric power plants constructed at the beginning of the twentieth century. Many have since been abandoned, with the advent of large central-station power plants. Craggy Dam on the French Broad River in North Carolina, built in 1904, is one of these abandoned plants. The owner of the property commissioned an engineer to evaluate the site for possible redevelopment for hydroelectric power purposes. The planning, feasibility, licensing, construction, and operation, of the plant and the associated problems that were encountered during project development are discussed. The powerhouse, with induction generators, exceeds its rating and is connected by a one-half-mile concrete-pole power line to the owners' wastewater treatment plant, where project power is utilized. Surplus power, about one third of the project's total output, is sold to the local electric utility. (Author's abstract)
W88-07505

SLURRY TRENCH OF BARRAGE OA-11, (LA TRANCHEE A BOUE LOURDE DU BARRAGE OA-11),
Moncton Univ. (New Brunswick). Ecole de Genie.
J. Pare.
Canadian Journal of Civil Engineering, Vol. 14, No. 6, p 844-856, 1987. 9 fig, 1 tab, 13 ref.

Descriptors: *Dams, *Dam construction, *Cutoffs, *Excavation, *Backfill, *Trenches, Diversion, Hydroelectric plants, Earthfill dams, Reservoirs, Opinaca Reservoir.

The OA-11 dam is the most important impounding structure of the Opinaca reservoir in Quebec created by the water diversion of the Eastmain, Petit Opinaca and Opinaca rivers to the La Grande River to increase the hydroelectric potential of the LG-2 power plant. With a maximum height of 32.2 m and a crest length of 3214 m, this earthfill dam was built on relatively pervious fluvio-glacial deposits that made it necessary to use two impervious deep cutoffs (a slurry trench and a cast-in-place concrete panel wall). On the right shore, a slurry trench, 2180 m long, 1.5 m wide, and varying in depth from 3 to 22.7 m, was built. The different construction phases of the slurry trench are described with emphasis on excavation and backfilling, and quality control. The slurry trench performance was assessed in terms of the pore pressures developed in the foundation and at the toe during and after reservoir filling. (Author's abstract)
W88-07509

THAILAND DAM CONTROVERSY,
For primary bibliographic entry see Field 6G.
W88-07559

WATER DISTRIBUTION SYSTEM INFRASTRUCTURE STUDY, CITY OF NORWICH, N.Y.,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5F.
W88-07729

INVESTIGATION OF SLURRY CUTOFF WALL DESIGN AND CONSTRUCTION METHODS FOR CONTAINING HAZARDOUS WASTES,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W88-07751

DEBRIS MANAGEMENT AT THE LOWER SUSQUEHANNA HYDROELECTRIC PROJECTS: STAFF REPORT,
Susquehanna River Basin Commission, Harrisburg, PA.
J. D. Graham, and R. A. Cairo.
Publication No. 95. Susquehanna River Basin Commission, Harrisburg, Pennsylvania. April 1985. 25 p.

Descriptors: *Flotsam, *Debris management, *Detritus, *Debris control, *Hydroelectric plants, Water quality management, State jurisdiction, Federal jurisdiction, Rivers, Susquehanna River.

Reviewed and summarized is pertinent information relating to the issue of debris management at the York Haven, Safe Harbor, Holtwood, and Conowingo Hydroelectric Projects located on the Susquehanna River. More specifically, this report describes the debris problem; traces Susquehanna River Basin Commission (SRBC) and Federal Energy Regulatory Commission (FERC) involvement in addressing the problem at lower Susquehanna River hydro sites; cites the legal authority available to deal with the problem; and examines the efforts made by similarly situated dam operators to deal with the problem. Specific, recommended programs to be planned and implemented by the Commission in coordination with appropriate representatives of Federal, State and private interests in the basin including: (1) to significantly expand existing efforts to remove floating debris from the river and its tributaries at sites where such material becomes trapped or can be readily collected, and (2) to initiate actions designed to reduce the amount of floatable debris that enters the river and its tributaries. (Lantz-PTT)
W88-07843

APPROPRIATE TECHNOLOGY FOR WATER RESOURCES DEVELOPMENT,
Agence Financiere de Bassin Seine-Normandie, Paris (France).
For primary bibliographic entry see Field 4B.
W88-07870

RESERVOIR TRAP EFFICIENCY,
Agricultural Research Service, Beltsville, MD. Hydrograph Lab.
H. G. Heinemann.
IN: Erosion and Sediment Yield: Some Methods of Measurement and Modelling. Geo Books, Regency House, Norwich (England). 1984. p 201-218, 7 fig, 26 ref.

Descriptors: *Reservoir silting, *Sedimentation, *Sediment transport, *Trap efficiency, *Reservoirs, *Sediment yield, *Sediment discharge, Sediment erosion, Storm runoff, Lake sediments, Overfalls, Sediment distribution, Agricultural runoff, Reservoir operation, Reservoir design, Mathematical models, Design criteria.

The processes occurring in agricultural reservoirs during an inflow event are described using flow diagrams, and the various parameters that influence sediment trap efficiency are discussed. The mechanics of reservoir silting are reviewed. The

determination of reservoir-sediment trap efficiency of existing reservoirs requires an accurate measurement of all sediment transported into the reservoir as well as the sediment discharged through the spillways. When methods for estimating reservoir-sediment trap efficiency were first proposed, they were based primarily on empirical relationships. A literature review of the evolution of the current state of the art for estimating reservoir-sediment trap efficiency is given. The estimated volume of sediment that will be trapped in a reservoir is one of the two components determining the design capacity of the reservoir. More quantitative research is needed on the sedimentation process and on the prediction and control of reservoir silting. More information is also needed on sedimentation processes in small reservoirs between runoff events. Flocculation and aggregation should be examined with regard to trap efficiency and predicting its effect in proposed reservoirs. (See also W88-07895) (Geiger-PTT)
W88-07903

8B. Hydraulics

WEAKLY NONLINEAR NON-SYMMETRIC GRAVITY WAVES ON WATER OF FINITE DEPTH,
California Inst. of Tech., Pasadena. Dept. of Applied Mathematics.
J. A. Zufiria.
Journal of Fluid Mechanics JFLSA7, Vol. 80, p 371-385, July 1987. 7 fig, 34 ref. Office of Naval Research N00014-79-C-0412 and NR062-639.

Descriptors: *Waves, *Gravity waves, *Water depth, *Hamiltonian models, *Mathematical models, *Non-symmetric waves, Mathematical equations, Mathematical studies.

A weakly nonlinear Hamiltonian model for two-dimensional irrotational waves on water of finite depth is developed. The truncated model is used to study families of periodic traveling waves of permanent form. It is shown that non-symmetric periodic waves exist, which appear via spontaneous symmetry-breaking bifurcations from symmetric waves. (See also W88-06816) (Author's abstract)
W88-06815

NON-SYMMETRIC GRAVITY WAVES ON WATER OF INFINITE DEPTH,
California Inst. of Tech., Pasadena. Dept. of Applied Mathematics.
J. A. Zufiria.
Journal of Fluid Mechanics JFLSA7, Vol. 181, p 17-39, August 1987. 8 fig, 6 tab, 30 ref. Office of Naval Research Grants N00014-79-C-0412 and NR062-639. National Science Foundation Grant OCE-8415988.

Descriptors: *Waves, *Gravity waves, *Water depth, *Hamiltonian models, *Mathematical models, *Non-symmetric waves, *Mathematical equations, Mathematical studies.

Two different numerical methods are used to demonstrate the existence of and calculate non-symmetric gravity waves on deep water. It is found that they appear via spontaneous symmetry-breaking bifurcations from symmetric waves. The structure of the bifurcation tree is the same as the one found by Zufiria for waves on water of finite depth using a weakly nonlinear Hamiltonian model. One of the methods is based on the quadratic relations between the Stokes coefficients discovered by Longuet-Higgins in 1978. The other method is a new one based on the Hamiltonian structure of the water-wave problem. (See also W88-06815) (Author's abstract)
W88-06816

EXPERIMENTAL AND THEORETICAL INVESTIGATION OF NONLINEAR SLOSHING WAVES IN A RECTANGULAR CHANNEL,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
E. Kit, L. Shemer, and T. Miloh.
Journal of Fluid Mechanics JFLSA7, Vol. 181, p 265-291, August 1987. 15 fig, 25 ref.

Descriptors: *Waves, *Sloshing waves, *Mathematical models, *Water tanks, *Mathematical studies, *Experimental data, Hysteresis, Mathematical equations, Artificial waves.

Experimental and theoretical studies of sloshing waves in a rectangular channel in the vicinity of the second cutoff frequency are presented. The experiments were performed in a wave tank which is 1.2 m wide, 18 m long and 0.9 m deep. Sloshing waves were generated by a computer-controlled segmented wavemaker consisting of four independent modules. A sharp transition between two wave patterns, which exhibited hysteresis-type behavior, was observed. At lower forcing frequencies a steady wave regime was obtained, while at higher frequencies modulation on a long timescale appeared. At stronger forcing, solutions were generated periodically at the wavemaker and then propagated away with a seemingly constant velocity. Experimental results are compared with numerical solutions of the appropriate nonlinear Schrodinger equation, a derivation of which is also presented. The importance of dissipation on the physical processes of wave evolution is discussed, and a simple dissipative model is suggested and incorporated in the governing equations. (Author's abstract)
W88-06817

CHANGE OF AMPLITUDE OF INTERACTING SOLITARY WAVES,
Dept. of Mathematics, Univ. of Edinburgh, Edinburgh EH9 3JZ, UK.
J. G. B. Byatt-Smith.
Journal of Fluid Mechanics JFLSA7, Vol. 182, p 485-497, September 1987. 1 fig, 21 ref.

Descriptors: *Waves, *Wave height, *Solitary waves, *Mathematical models, *Mathematical studies, *Mathematical equations, Euler equations.

In this paper the solitary-wave solutions of the Euler equations of motion are treated as a perturbation of the KdV equation. It is shown analytically, that the amplitudes of two solitary waves are altered after interaction. This change in amplitude is calculated, showing that the smaller wave decreases in amplitude and the larger wave increases in amplitude. (Author's abstract)
W88-06818

MATHEMATICAL ASPECTS OF TRAPPING MODES IN THE THEORY OF SURFACE WAVES,
Dept. of Mathematics, Univ. of Manchester, Manchester M13 9PL, UK.
F. Ursell.
Journal of Fluid Mechanics JFLSA7, Vol. 183, p 421-437, October 1987. 13 ref.

Descriptors: *Waves, Canals, *Mathematical models, *Trapping modes, *Mathematical equations, *Hydrodynamics, Stokes law, Mode of action, Open channels.

A horizontal canal of infinite length and of constant width and depth contains inviscid fluid under gravity. The fluid is bounded internally by a submerged horizontal cylinder which extends right across the canal and has its generators normal to the sidewalls. Suppose that the fluid is set in motion by a surface pressure varying across the canal, then some of the energy is radiated to infinity while some of the energy is trapped in characteristic modes (bound states) near the cylinder. The existence of trapping modes in special cases was shown by Stokes and later by Ursell (1951); a general treatment, given by Jones, is based on the theory of elliptic partial differential equations in unbounded domains. In the present paper a much simpler treatment is given which uses only the theory of bounded symmetric linear operators together with Kelvin's minimum-energy theorem of classical hydrodynamics. (Author's abstract)
W88-06819

TIDAL RECTIFICATION IN LATERAL VISCOUS BOUNDARY LAYERS OF A SEMI-ENCLOSED BASIN,
Centre for Mathematics and Computer Science, P.O. Box 4079, 1009 AB Amsterdam, The Netherlands.
For primary bibliographic entry see Field 2L.
W88-06820

ENERGY LOSSES AND FLOATING BREAKWATER RESPONSE,
Dept. of Hydrology and Environmental Engineering, Univ. of Pavia, 27100 Pavia, Italy.
M. Fugazza, and L. Natale.
Journal of Waterway, Port, Coastal, and Ocean Engineering JWPED5, Vol. 114, No. 2, p 191-205, March 1988. 13 fig, 20 ref, 1 append.

Descriptors: *Floating breakwaters, *Energy loss, *Hydrodynamics, *Breakwaters, *Mathematical models, *Mathematical analysis, *Caissons, *Wave Height, Wave refraction, Floating.

Very often the linear models of floating caisson breakwaters simulate the complete hydrodynamic phenomenon by dividing it into elementary problems, such as wave diffraction around a fixed surface body, motion of the moored structure caused by the wave, and change of the wave field due to waves generated by the breakwater. The authors show that in the particular case of floating breakwaters, the superposition, which uncouples the wave diffraction and the body movement, neglects important effects of coupled phenomena and introduces errors into the simulation. The present paper suggest some corrections, which, can account for the nonlinearity of the coupled phenomenon. Furthermore, laboratory tests check the validity of the theoretical solutions of the elementary problems, the result obtained by working out these solutions, and the effectiveness of the proposed coefficients of added mass, calculated on the usual assumption of potential flow, underestimate experimental values. Moreover, the experimental results presented by other authors are explained with the proposed mathematical model. (Author's abstract)
W88-06852

RESTORING THE SINUOSITY OF ARTIFICIALLY STRAIGHTENED STREAM CHANNELS,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
For primary bibliographic entry see Field 4A.
W88-06962

SELECTING OPTIMAL PIPE SIZES FOR WATER DISTRIBUTION SYSTEMS,
Systems Planning Div. of the Austin, Texas, Water and Wastewater Utility.
For primary bibliographic entry see Field 5F.
W88-07035

BOAT TRAFFIC, SEDIMENT RESUSPENSION AND TURBIDITY IN A BROADLAND RIVER,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-07207

STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS,
Department of Civil Engineering, Swiss Federal Institute of Technology, Zuerich, Switzerland.
T. Dracos, and P. Hardegger.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 169-185, 1987. 7 fig, 4 tab, 18 ref.

Descriptors: *Floods, *Stage-discharge relations, *Flow characteristics, *Steady flow, *Uniform flow, *Flood plains, *Flow channels, *Mathematical models, Flooding, Overland flow, Stage-discharge relations, Flow discharge, Hydraulic roughness, Roughness coefficient, Hydraulic radius.

During larger floods the water rises above bankfull stage in the main channel of many rivers and overland flow occurs over the flood plains. Most of the methods used for the computation of uni-

form flow in channels with flood plains are based on a separate determination of the flow in the main channel and the flood plains. A single-channel method is proposed which allows the direct determination for the stage-discharge relation in a channel with a flood plain. The method presented for the computation of the depth-discharge relation in compound channels is based on experimental results published by other investigators. For channels with roughness of the flood plains different from the roughness of the main channel an effective roughness coefficient must first be computed by using the Einstein-Horton formula. The approach is empirical and gives satisfactory results. The results observed when using the data of experimental work conducted at the University of Illinois, that when the flow depth over the flood plains exceeded a distinct value the best results were obtained by treating the compound channel as a single channel with constant roughness coefficient, are in good agreement with the results of the present work. An analysis of the flow in natural rivers with flood plains also showed that the influence of the flood plains becomes negligible when the flow depth over the flood plain exceeds a given limit; this is only a crude test of the proposed method but still gives the right order of magnitude for a given flow depth as computed from a given ratio of the hydraulic radius to flow depth. (Shidler-PTT)
W88-07245

PERTURBATION SOLUTION OF THE FLOOD-ROUTING PROBLEM,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-07246

GRADUALLY-VARIED FLOWS IN OPEN-CHANNEL NETWORKS,
Stoner Associates, Carlisle, PA.
For primary bibliographic entry see Field 2E.
W88-07249

EXPERIMENTAL VERIFICATION OF THE DRESSLER CURVED-FLOW EQUATIONS,
George Washington Univ., Washington, DC. International Water Resources Inst.
For primary bibliographic entry see Field 2E.
W88-07250

DESIGN OF STABLE ALLUVIAL CHANNELS,
Hydraulics and Coastal Engineering Group, Kuwait Institute for Scientific Research, P. O. Box 24885, Safat, Kuwait.
For primary bibliographic entry see Field 2E.
W88-07252

NONLINEAR SOLUTION OF AGGRADATION AND DEGRADATION IN CHANNELS,
Detroit Water and Sewerage Dept., MI.
For primary bibliographic entry see Field 2J.
W88-07253

HYDRAULIC JUMP IN TRIANGULAR CHANNEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager, and R. Wanoschek.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 5, p 549-564, 1987. 12 fig, 16 ref.

Descriptors: *Hydraulic jump, *Energy dissipation, *Overflow channels, *Spillways, *Stilling basins, *Channel morphology, Mathematical models, Hydraulic models, Water surface profiles, Flow characteristics, Velocity distribution, Tailwater.

Usually, the main element of a hydraulic jump stilling basin is a rectangular channel with a protected bottom; the question arises whether the basic element, the rectangular channel, could not be modified into another structural shape by which the energy dissipation is significantly increased. Hydraulic jump in triangular channels was analyzed and the results confirmed using model observations. Length characteristics, surface profiles, and typical velocity distributions are discussed. These results compare with the hydraulic jump in rectangular channels as follows: (1) The sequent depth ratio (and therefore the tailwater depth) in the triangular channel is significantly lower than in the corresponding rectangular channel. (2) As a consequence, the relative energy dissipation of the jump in the triangular channel is much higher (typically, 30%) than in the rectangular channel. (3) The jump in the triangular channel is almost two times shorter than in the rectangular. (4) However, the volume of the jump is about 30% higher in the triangular channel. (5) The surface width at the end of the jump is larger in the triangular than in the rectangular channel; therefore, lateral space limitations may become important. (6) The sensitivity of the hydraulic jump to slight discharge variations is lower in the triangular channel; as a consequence, the sensitivity to slight tailwater variations is higher. (Shidler-PTT)
W88-07254

OVERVIEW OF LANDFILL BOTTOM LINER HYDRAULICS,
Department of Civil Engineering, University of Patra, Patra, Greece.
For primary bibliographic entry see Field 5E.
W88-07277

ANALYSIS OF THE DESIGN STORM TIME-INTENSITY PATTERN FOR MEDIUM AND SMALL WATERSHEDS,
Hydrological General Station of Guangdong Province, Canton (P.R. of China).
For primary bibliographic entry see Field 2B.
W88-07407

DETERMINATION OF DESIGN FLOODS USING STORM DATA,
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 2B.
W88-07408

COMPUTATION OF SUPERCRITICAL FREE-SURFACE FLOWS,
Instituto Costarricense de Electricidad, San Jose.
O. F. Jimemez, and M. H. Chaudhry.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 4, p 377-395, April 1988. 13 fig, 38 ref.

Descriptors: *Channel flow, *Rapid flow, *Shallow water equations, *Supercritical flow, *Hydraulic models, *Mathematical analysis, *Simulation analysis, Boundary conditions, Hydrostatic pressure, Finite difference methods.

Computational methods for the solution of two-dimensional shallow-water equations in steady, supercritical flow are presented. The limitations of these equations and criteria regarding their applicability to the solution of supercritical flows are discussed. Two explicit, shock-capturing, finite-difference schemes, Lax and MacCormack, were investigated. The boundary conditions along walls require careful attention for a successful implementation of these schemes. Comparison of the numerical and analytical solutions indicate that, with proper treatment of the boundaries, very good agreement can be obtained. Comparison of numerical and experimental results showed that the assumption of hydrostatic pressure distribution imposes restrictions on the utility of the shallow-water equations to represent the steady, supercritical flow. However, it appears that the basic features of many practical problems may be simulated using these procedures. (Author's abstract)
W88-07430

GRAVITY-AFFECTED POTENTIAL FLOWS PAST SPILLWAY FLIP BUCKETS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
L. Shuguang, and L. Zhengxiang.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 4, p 409-427, April 1988. 5 fig, 1 tab, 8 ref.

Descriptors: *Dam design, *Potential flow, *Spillways, *Flip buckets, *Hydraulics, *Hydrodynamics, *Gravity flow, Mathematical analysis.

Previous analytic studies on potential flows past spillway flip buckets have almost always been done based on the essential assumption that gravity effects on the bucket flows can be neglected. This limits their applications only to flows with very large Froude numbers past very high dams. The Riemann-Hilbert mixed-boundary value problem technique was used to solve the gravity-affected potential flows through curvilinear and straight segmental flip buckets. Pressure distributions along the flip buckets and exit angles of the deflecting jet were computed by solving the resulting integral equations. Experimental data on pressure distributions along the bucket were compared with this theoretical analysis; it is shown that the agreement is satisfactory. This is a great improvement over the previous solutions in the absence of gravity. (Author's abstract)
W88-07432

DIVISION OF FLOW IN SHORT OPEN CHANNEL BRANCHES,
Concordia Univ., Sir George Williams Campus, Montreal (Quebec). Dept. of Civil Engineering.
A. S. Ramamurthy, and M. G. Satish.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 4, p 428-438, April 1988. 5 fig, 1 tab, 17 ref.

Descriptors: *Channel flow, *Hydraulic models, *Mathematical analysis, Froude number, Model studies.

A theoretical model for division of flow in a short branch channel set at right angles to a main channel was developed for various width ratios of the branch channel to the main channel. The model uses the principles of momentum, energy, and continuity and is based on the existence of free flow conditions in the branch channel. The analysis makes use of the similarity of flow configuration between the division of flow in a branch channel and in a two-dimensional lateral conduit outlet fitted with a barrier. This similarity of flow was used to estimate the contraction coefficient of the converging jet entering the branch channel. The ratio of the branch channel flow to the main channel flow is related to the Froude number in the main channel section downstream of the junction. Data from experimental studies, and from earlier investigations are presented to validate the theoretical model. (Author's Abstract)
W88-07433

STRUCTURAL BEHAVIOUR OF CLOSELY PACKED EGG-SHAPED SEWER LININGS DURING INSTALLATION AND UNDER VARIOUS RESTRAINT CONDITIONS,
WRC Engineering, Swindon (England).
S. Arnaout, M. N. Pavlovic, and J. W. Dougill.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 85, No. 2, p 49-65, March 1988. 11 fig, 3 tab, 3 ref.

Descriptors: *Sewer systems, *Design criteria, *Design standards, *Sewer linings, *Grouting, *Pipe lining, Maintenance.

A parametric study was conducted of the structural response of closely packed egg-shaped sewer linings, including the effect of various restraint conditions which simulate different temporary support systems used by contractors during installation. Based on the allowable stress and deflexion criteria specified in the WRc sewerage rehabilitation manual, a comprehensive set of design curves are presented, covering the practical range of geometric, material and loading parameters. A comparison between the various types of restraint leads to enhancement factors for the permissible grouting pressure or, alternatively, to reduction factors in terms of the lining thickness which could be used in designing lining systems. (Author's abstract)
W88-07476

SIMULATIONS OF THE WAVES IN LAKE BOTNEN CREATED BY THE RISSA LANDSLIDE,
University of Strathclyde, Glasgow (Scotland).
For primary bibliographic entry see Field 2H.
W88-07478

FLOOD ALLEVIATION SCHEME FOR LOWER RIVER MOLE,
W. E. Foster, and W. B. Harris.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 84, Pt. 1, p 235-263, April 1988. 17 fig, 1 tab, 16 ref, append.

Descriptors: *Flood control, *Flood channels, *England, *Bank protection, *Bank stabilization, Sluices, Structural engineering, Watershed management.

Severe rain storms in September 1968 probably the worst experienced in Southeast England in the 20th Century up to that time, resulted in flood water from the River Mole damaging 10,000 properties in Esher and East Molesey. It was decided that the channel should be modified to convey a similar flood with safety. The design and execution of the 19 million-English pound flood alleviation works 1975-89 is described. The evolution of the scheme was specifically required to minimize impact on property and environment. The extent of bed and bank revetment required for the new 6 km-long flood channel was determined after examining the relationship between flood return periods, unit tractive forces and shear resistance of the soil and then assessing capital and maintenance costs of various types of revetment. New control sluices were constructed and the solution of a problem of nappe oscillation at the radial gate is described. Reference is made to the complete underpinning of a much used 150-year-old railway viaduct, fluming and reconstruction of other bridges and the use of steel piling in various forms The universal piling retained after submersion for 50 yr. was examined. Extensive use was made of ground anchorages; their installation and testing are described. Special regard was given to landscapinp. (Freidmann-PTT)
W88-07489

SECONDARY CURRENTS IN STRAIGHT WIDE CHANNELS,
Democritus University of Thrace, 67100 Xanthi, Greece.
For primary bibliographic entry see Field 2E.
W88-07493

WAVE ATTENUATION BY RUBBLE-LINED CHANNEL WALLS,
National Water Research Inst., Burlington (Ontario).
C. T. Bishop.
Canadian Journal of Civil Engineering, Vol. 14, No. 6, p 828-836, 1987. 13 fig, 1 tab, 16 ref.

Descriptors: *Coastal engineering, *Model studies, *Harbors, *Waves, *Wave action, *Channel flow, Wave attenuation, Hydrologic models, Coastal waters, Gravel, Canal linings, Walled channels.

An existing analytical model to predict wave attenuation in a straight vertically walled channel with one or both walls lined with rubble is tested and modified. Placing rubble at side slopes of 1.5 or 2 to 1 along vertical entrance channel walls is a technique used more and more to correct wave agitation problems in harbors. Tests were conducted in a laboratory flume with monochromatic waves and four different sizes of stone from 7.7 mm gravel to 90 mm gabion stone. The attenuation coefficient is found to vary with the ration of water depth to period squared, d/gT squared, with the relative channel width, w/d, and with the side slope of the rubble, m. Preliminary design curves are provided which allow a desk assessment of this technique to be made for a given harbor. The scale effects on wave attenuation due to stone size or shape appear to be negligible. Reynolds number scale effects are also shown to be unimportant over the range tested. (Author's abstract)
W88-07508

RUNOFF COLLECTOR AND FLUME FOR USE ON BARE FALLOW PLOTS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 7B.
W88-07694

8C. Hydraulic Machinery

STATE SPACE APPROACH TO THE BEHAVIOUR OF SEWER SYSTEMS,
Sewer Department of Public Works, The City of Barcelona, Spain.
For primary bibliographic entry see Field 5D.
W88-07247

YACYRETA BI-NATIONAL HYDROELECTRIC DEVELOPMENT,
Entidat Binacional Yacyreta; E. Madero 942 - 1106 Buenos Aires, Argentina.
For primary bibliographic entry see Field 8A.
W88-07454

HYDROPOWER DEVELOPMENT ON THE HUALLAGA RIVER IN PERU,
Shawinigan Engineering Co. Ltd., Montreal (Quebec). Hydro-Electric Div.
For primary bibliographic entry see Field 8A.
W88-07455

HYDRO IN BRAZIL: RESOLVING ENVIRONMENTAL CONFLICTS,
Eletrosul, PO Box D-17, 88048 Florianopolis, Santa Catarina, Brazil.
G. V. Canali, H. R. Munoz, and M. A. Schwab.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 34-36, April 1988. 2 tab, ref.

Descriptors: *Dam construction, *Hydroelectric power, *Dam design, *Economic aspects, *Brazil, *Uruguay, Civil engineering, Developing countries, Water resources development, Hydrology, Construction.

An attempt by the Brazilian Power Authority, Eletrosul, to incorporate environmental aspects, as decision variables, at an early stage of planning of the Uruguay river basin development on the border of Santa Catarina and Rio grande do Sul is described. The case study demonstrates clearly the need for the socio-political feasibility of a scheme to be taken into account, as well as technical and economic aspects, and also for the public to be kept well informed during the planning process. Many valuable lessons have been learned from the problems which arose with the Uruguay river project, and these will be used to refine future planning and development procedures. (Author's abstract)
W88-07456

120 MW URUGUA-I SCHEME INCORPORATES ARGENTINA'S FIRST R.R.C. DAM,
Tamrock, PO Box 279, SF-33101 Tampere, Finland.
For primary bibliographic entry see Field 8A.
W88-07458

FULL-SCALE TESTING OF SMALL HYDRO TURBINES,
Dept. of Electrical and Electronic Engineering, The Queen's Univ. of Belfast, Ashby Building, Stranmillis Road, Belfast BT9 5AH, UK.
A. Refsum, and D. C. H. Thompson.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 52-53, April 1988.

Descriptors: *Electric powerplants, *Powerplants, *Hydraulic equipment, *Design standards, *Design criteria, *Hydroelectric power, *Turbines, Civil engineering, Economic aspects, Testing.

Efforts to reduce the costs of small hydro plants by developing unconventional designs and by using new materials in their construction are often frustrated by the lack of appropriate testing facilities. It is helpful in the development of such designs to be able to test full-scale prototypes; however, the main problem with full-scale testing, away from the actual site, is the difficulty of achieving the full flow rate for any length of time. A method was developed recently at Queen's University, Belfast, whereby a low-head Pelton wheel driving a 3 kW induction generator was tested, with full flow rate and head, on a temporary installation. The method could be used for low-cost testing of other types of experimental low-head turbine. (Author's abstract)
W88-07459

ASSESSING THE DESIGN OF DRAFT TUBES,
Hydro Pacific, 23 McClintock Road, Massey, Auckland, New Zealand.
R. J. Hothersall.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 55-57, April 1988. 5 fig, 2 tab, 6 ref.

Descriptors: *Design standards, *Design criteria, *Hydraulic equipment, *Hydroelectric power, *Turbines, *Draft tubes, Economic aspects, Civil engineering, Energy.

The draft tube is an essential feature of the reaction turbine. Its design not only affects turbine peak efficiencies, but also other aspects such as operating procedure at part load, and station costs, through machine spacing and required excavation depth. The consultant should consider certain aspects of draft tube design when writing the tender specification for a new turbines: The draft tube is only capable of recovering a fixed proportion, typically 85%, of the energy put into it. The energy which needs to be recovered at the runner exit is a function of specific speed; the lower the specific speed, the less energy needs to be recovered. Economic values should be assigned to draft tube dimensions which take into account changing fuel costs over the lifetime of the plant. Consideration should be given to the use of the IEC or ASME code definition of net head. Turbine manufacturers tend to prefer the use of the IEC definition. The ASME definition is dependent on the tailrace velocities. These velocities may vary from plant to plant, and make the comparison of turbine efficiencies less direct. (Alexander-PTT)
W88-07460

SIPHON-MOUNTED KAPLAN TURBINES AS TWO FRENCH MINI HYDRO SCHEMES,
Neyrpic, Grenoble (France).
R. Pontier.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 57-58, April 1988.

Descriptors: *Hydraulic equipment, *Design standards, *Design criteria, *Powerplants, *Electric powerplants, *Hydroelectric power, *Kaplan turbines, Civil engineering, Economic aspects, France, Flow control.

The siphon-mounted Kaplan turbine, reduces the amount of excavation and civil works construction at low head small hydro schemes. The requirement for a headgate is also eliminated, because a vacuum pump and break valves control the flow. The machines, developed and standardized by the French manufacturer Neyrpic, have been installed at two small hydro schemes in France. The machines do not require gates for start up and shutdown, reducing equipment costs compared with conventional low-head machines. Start-up is achieved by priming the siphon through a vacuum pump, and shutdown by opening the break valves. The turbines are pre-assembled in the workshop, and can be installed on site quite rapidly. The mechanical and auxiliary equipment (such as the runner, seal and speed increaser) as well as the generator, are located above the upstream water level, so that the units do not need to be dewatered for inspection and maintenance purposes. The turbines incorporate a fixed distributor, and can either have fixed blades, or, as in both examples described, controllable blades. Blade orientation is achieved by a programmable controller in accord-

ance with a discharge setting value determined by measuring upstream level variations. The generator is outside the hydraulic conduit, and is therefore easily accessible. The generator is connected to the turbine through a speed increaser which is a simple belt and pulley system. For larger capacity machines, the speed increaser will be of the parallel shaft type. (Alexander-PTT)
W88-07461

MODELLING AN ADJUSTABLE NOZZLE FOR THE CROSS FLOW TURBINE,
Technische Hogeschool Eindhoven (Netherlands).
J. van Berkel.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 4, p 60-65, April 1988. 6 fig, 9 ref.

Descriptors: *Model studies, *Hydraulic equipment, *Design standards, *Powerplants, *Electric powerplants, *Design criteria, *Hydroelectric power, *Cross flow turbines, *Nozzles, Economic aspects, Civil engineering, Flow.

A new design is proposed for an adjustable nozzle for the cross flow turbine, and four models are described by which relevant design features of the nozzle can be quantified. The design is based on a butterfly valve, and the models provide information about the flow inside, and the control characteristics of, the nozzle. Three models are theoretical and based on an incompressible, frictionless (non-viscous) and non-turbulent flow, a special feature being the presence of free streamlines. The solution procedure for the model equations is numerical. A scale model was used to validate one theoretical model. Although the modelling is not completed (one theoretical model is still speculative), a tentative design procedure could be drawn up by which a nozzle can be designed with a low flow resistance, a simple geometry and good control characteristics. (Author's abstract)
W88-07462

HYDROPOWER PLANNING IN DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 6A.
W88-07504

REDEVELOPMENT OF AN ABANDONED SMALL HYDRO PROJECT,
Hendon Engineering Assoc., Inc., P.O. Box 20348, Birmingham, AL 35216.
For primary bibliographic entry see Field 8A.
W88-07505

SOLAR ENERGY FOR PUMPING WATER,
Grundfos International A/S, Denmark.
M. Arbon, and L. T. Nielsen.
Water Resources Journal, No. 154, p 53-57, September 1987. 10 fig.

Descriptors: *Hydraulic machinery, *Pumps, *Energy sources, *Wells, *Solar energy, Electric power production, Deep wells.

Basic principles of electric power generation from solar energy are described. Silicon cells are most commonly used. These are doped by injecting either phosphorus atoms or boron atoms, producing n-type and p-type crystals, respectively. Only visible radiation may be used to generate power. Three types of light impinge upon a solar cell: direct, diffuse, and reflected. Efficiency of the cell is highest at low temperatures. Current requirements for solar pumping systems for developing countries are: guaranteed life of at least 10 years for all components, guarantee of optimum utilization of the plant, and utility for well depths in excess of hand pumped wells. The advantages and disadvantages of three systems are described: the direct coupled dc electric motor, the charge controller with storage battery and dc electric motor, and the dc/ac three-phase inverter and three-phase electric motor. All systems, especially the last, are sophisticated and pose problems where technology is primitive. Pumps suitable for use with solar energy are deep well submersible centrifugal pumps of stainless steel, deep well helical rotor pumps, and deep well reciprocating pumps. Deep well turbine pumps only partially fulfill operating requirements, and deep well ejector pumps are not suitable because of low efficiency. (Cassar-PTT)
W88-07557

DEBRIS MANAGEMENT AT THE LOWER SUSQUEHANNA HYDROELECTRIC PROJECTS: STAFF REPORT,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 8A.
W88-07843

8D. Soil Mechanics

CIVIL ENGINEER'S POINT OF VIEW ON WATER TIGHTNESS AND CLOGGING OF WASTE STABILIZATION PONDS,
CEMAGREF, Division Mecanique des Sols et Genie Civil, B.P. 121, 92164 Antony Cedex, France.
For primary bibliographic entry see Field 5D.
W88-07370

PILE LOAD TESTS IN SALINE PERMAFROST AT CLYDE RIVER, NORTHWEST TERRITORIES,
Hardy, BBT Limited, 221 - 18th St. S.E., Calgary, Alta., Canada T2E 6J5.
For primary bibliographic entry see Field 8G.
W88-07425

PREDICTION OF WICK DRAIN PERFORMANCE USING PIEZOMETER CONE DATA,
British Columbia Univ., Vancouver.
P. K. Robertson, R. G. Campanella, P. T. Brown, and K. E. Robinson.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 1, p 56-61, February 1988. 7 fig, 15 ref.

Descriptors: *Drainage engineering, *Soil mechanics, *Clays, *Wick drains, *Piezometers, Testing procedures.

The technique of installing prefabricated wick drains is well established in Europe and Japan, but is relatively new to North America. The use of piezometer cone data to predict the performance of wick drains in a soft clayey silt in Burnaby, British Columbia is discussed. A description of the testing procedures and the theory to calculate the rate of consolidation are presented. The predicted rate of consolidation using the piezometer cone data and the measured performance were compared; good agreement between the two was found. (Author's abstract)
W88-07426

TILL BEHAVIOR AND ITS RELATIONSHIP TO ACTIVE-LAYER HYDROLOGY, DISTRICT OF KEEWATIN, NORTHWEST TERRITORIES,
Department of Geological Sciences, Queen's University, Kingston, Ont., Canada K7L 3N6.
L. Dyke, and P. Egginton.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 1, p 167-172, February 1988. 9 fig, 14 ref.

Descriptors: *Groundwater movement, *Arctic zones, *Soil water, *Tills, *Hydrology, Liquefaction, Bedrock, Northwest Territories, Canada, Soil compaction, Ice lenses, Thawing.

Well-graded tills are a common surficial material over much of the Canadian Arctic from northern Manitoba to Somerset Island. The compactibility and bearing strength of these tills when thawed appear to be controlled by groundwater flow in the active layer. Water seeping from bedrock outcrops flanked by till enters the till active layer and flows via macropores formed as ice lenses thaw. This flow appears to retard consolidation of the till. Slopes having no seepage source consolidate more rapidly. This seepage maintains the till in a state highly susceptible to liquefaction and would yield material with a moisture-density condition unsuitable for construction use. (Author's abstract)
W88-07428

UPFREEZING PROCESS: EXPERIMENTS WITH A SINGLE CLAST,
Washington Univ., Seattle. Quaternary Research Center.
For primary bibliographic entry see Field 2C.
W88-07954

8E. Rock Mechanics and Geology

POTENTIAL GEOLOGIC HAZARDS NEAR THE THISTLE LANDSLIDE, UTAH COUNTY, UTAH,
US Geological Survey, Federal Center, Denver, CO 80225.
I. J. Witkind.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. XXV, No. 1, p 83-94, February 1988. 8 fig, 1 tab, 22 ref.

Descriptors: *Geologic formations, *Landslides, *Earth dams, *Dam stability, *Geologic fractures, *Damsites, Artificial lakes, Utah, Spanish Fork River, Reservoirs.

In mid-April, 1983, an old landslide near Thistle, in Utah County, Utah began to move, and within days had blocked Spanish Fork Canyon. As the slide's movement continued, construction crews gradually converted the toe of the slide into an earth-filled dam - Thistle Dam - that impounded northwest-flowing Spanish Fork River. The resultant reservoir, known as Thistle Lake, was subsequently drained because of uncertainty about the stability of the dam. Recently, officials of Utah County have explored various alternatives for a water-retention structure in the area, including utilization of Thistle Dam. The Thistle Slide Committee, established by the State of Utah to evaluate the suitability of using Thistle Dam, suggests that construction of a new dam upstream from the present one might be a more reasonable and cheaper solution than investigating the stability of the present dam. Two potential geologic hazards could impact a dam site upstream from the Thistle Dam: the Thistle Canyon fault and the Thistle Creek diapiric fold. Uncertainty shrouds the existence of both. The Thistle Canyon fault is a postulated high-angle normal fault that trends about N20 degrees E through Thistle. The Thistle Creek diapiric fold theoretically trends about N30 degrees E through the area. Tenuous evidence suggests that the Middle Jurassic Arapien Shale, an evaporite-rich intrusive sedimentary unit that forms the core of the fold, was overridden by the upper plate of the Charleston-Nebo thrust fault. Since then, the Arapien has welled upward, arching both the thrust plate and the overlying younger sedimentary cover. Additional field investigations should be completed to determine the existence of these and other geologic hazards prior to any final decision about a new dam. The presence of either or both of these hazards, however, does not necessarily preclude the construction of a safe and stable dam that would impound a multi-purpose reservoir. (Author's abstract)
W88-06849

SEISMICITY AROUND BRAZILIAN DAM RESERVOIRS,
University of Western Ontario,, Department of Geology, N6A 5B7, London, Ontario.
P. E. F. P. Coelho.
Environmental Geology and Water Sciences EGWSEI, Vol. 10, No. 3, p 149-158, 1987. 6 fig, 2 tab, 9 ref.

Descriptors: *Rock mechanics, *Seismicity, *Reservoirs, *Dams, Dam failure, *Earthquakes, Reservoir stages, Brazil, Cajuru Dam, Capivara Dam, Capivari-Cachoeira Reservoir, Paraitinga Dam, Porto Colombia-Volta Grande hydroelectric system, Nuporanga Dam.

Six cases of seismicity around dam reservoirs in Brazil are described. Seismic activity (4.7 Richter

scale) at the Cajuru Dam (earthfill/concrete gravity, 190 million cu m water) was considered of natural origin because of a history of quakes in the area. Capivara Dam (earthfill/buttress, 10.5 billion cu m water) experienced seismicity as much as IV Mercalli scale from April 1 to June 30, 1976, due to increase of pore pressure in basalt subhorizontal joints. Reservoir loading, which had begun on January 1 of that year, was deemed the cause of the seismicity. Shocks up to IV-V Mercalli scale were felt after impounding of the reservoir at Capivari-Cachoeira, with 180 million cu m impounded by an earthfill dam. This seismicity was attributed to increases in pore pressure in subvertical and included faults in the area of high residual stress. Although some rare and low-intensity earthquakes had been felt in the area of the Paraitinga Dam, seismic activity increased to over 5 (Richter scale) on several occasions after impoundment began. This was related to pore pressure increases in interlayer joints and faults in areas subject to high residual stresses causing generalized slope failure. The Porto Columbia (1.46 billion cu m) and Volta Grande (2.3 billion), two adjacent earthfill/concrete gravity dams, were the sites of a 5.1 (Richter scale) shock on February 24, 1974 after impoundment began at both dams. This seismicity was induced by increases in pore pressure in permeable intertrap horizons or subhorizontal joints in basalts. All cases of induced seismicity appear related to an increase in pore pressure in permeable rocks or fracture zones which are confined between impermeable rock slabs of more competent rock. Geological framework was considered an important factor, not dam height or size. High residual stress was also an important precondition for quakes in some cases. (Cassar-PTT)
W88-06880

RECENT U.S. HOT DRY ROCK TESTING AND HYDROTHERMAL MODELING,
Los Alamos National Lab., NM.
S. Kelkar, and M. V. Malzahn.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-008996. Price codes: A02 in paper copy, A01 in microfiche. Report No. LA-UR--87-1256, (1987). 14 p, 10 fig, 1 tab, 18 ref. DOE Contract No. W-7405-ENG-36.

Descriptors: *Reservoirs, *Hydraulic models, *Hot Dry rock reservoir, *Geothermal resources, *Rock mechanics, *Fenton Hill, *New Mexico, Simulation analysis, Hydraulic simulation, Hydraulic structures, Stress analysis, Field tests, Heat transfer, Fluid flow.

Testing is in progress at the site of the U.S. Hot Dry Rock (HDR) reservoir at Fenton Hill, New Mexico. Several hydraulic simulation tests have been conducted in the reservoir since January 1985. The reservoir being tested is at a nominal depth of 2650 m (11,975 ft). In a successful flow-through test conducted in 1986, 37,000 cu m of cold water was injected at controlled rates up to 0.0265 cu m/sec. During this test, 23,000 cu m (6.1 million gal) of hot water at temperatures up to 190 C was recovered, corresponding to 9 MW thermal power. The injection of large amounts of cold water at high pressures into the naturally fractured, granitic formation leads to complex flow fields, strongly influenced by coupled fluid flow, heat transfer and stress effects. In order to predict reservoir performance over time spans of interests (about 20 years) it is necessary to evaluate the influence of these coupled processes. This need has led to efforts to upgrade an existing finite element, heat and mass transfer code to include coupled stress effects while retaining the computational efficiency needed for simulations of long term reservoir performance. This paper describes field test results, a conceptual model of the reservoir, and code development efforts. (Author's abstract)
W88-07966

8F. Concrete

DEMONSTRATION OF THE CONSTRUCTIBILITY OF A PRECAST CONCRETE STAY-IN-PLACE FORMING SYSTEM FOR LOCK WALL REHABILITATION.
ABAM Engineers, Inc., 33301 Ninth Ave. South, Federal-Way, Washington.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report No. REMR-CS-14, December 1987. Final Report. 206 p, 30 fig, 2 tab, 4 ref, 5 append.

Descriptors: *Hydraulic structures, *Lock walls, *Materials testing, *Precast concrete, Concrete construction, Concrete technology, Costs, Locks, Construction methods.

One approach to minimizing the cracking problem in lock wall resurfacing is to use precast panels as stay-in-place forms. A precast panel rehabilitation system was designed in Phase I of a contract with the Waterways Experiment Station (WES). Phase II was a constructibitity demonstration in which eight panels were precast and erected on two one-half scale simulated lock wall monoliths at WES. The purpose of the demonstration was to evaluate the feasibility of the stay-in-place forming system without the risk and investment of undertaking a full-scale lock rehabilitation. The concrete form panels of varying sizes were precast in Colorado and shipped to the installation site at WES. Typical lock hardware incorporated into the precast panels included horizontal armor, vertical corner armor, and a one-half scale line hook. One panel was essentially prototype size (6 ft by 30 ft) and weighed approximately 15,500 lb. Work associated with installation of the precast panels included surface preparation on the test monoliths, erection and alignment of the panels, and welding tie connections. The panels were attached to the test monolith with epoxy-grouted, weldable-grade reinforcing steel which was welded to steel plates embedded in the panels. Results demonstrate that a precast concrete stay-in-place forming system is a viable method for lock wall resurfacing. In addition to providing a concrete surface of superior durability with minimal cracking, the estimated construction cost is very competitive with the cost of conventional forming and concrete placement. This repair system can be implemented with intermittent lock openings which would eliminate the lengthy and continuous closures required for conventional repairs. (Lantz-PPT)
W88-07983

8G. Materials

PILE LOAD TESTS IN SALINE PERMAFROST AT CLYDE RIVER, NORTHWEST TERRITORIES,
Hardy, BBT Limited, 221 - 18th St. S.E., Calgary, Alta., Canada T2E 6J5.
J. F. Nixon.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 1, p 24-32, February 1988. 11 fig, 1 tab, 14 ref.

Descriptors: *Piles, *Load tests, *Permafrost, *Soil properties, *Saline soils, Testing procedures, Arctic zone.

Significant salt content in the pore phase of permafrost causes dramatic reduction in strength or bearing capacity. Previous laboratory tests and limited field testing indicate that creep rates can be accelerated many times and foundation bearing capacities reduced by factors of 2-3 if pore water salinities exceed 10-20 ppt. At Clyde River on Baffin Island, pile load tests were carried out in 1982. A combination of high salinities and significant excess ice contents at some locations suggested that a limited program of pile load testing should be carried out to confirm or modify the initial pile loadings based on previously published material. No fully documented case history was available to support initial pile design loads. Three piles were subjected to loads of 5 different magnitudes for different durations. Creep settlement was initiated and persisted in all cases. Continuous curve fitting was carried out by computer, and the resulting smoothed strain rate plotted with time. The minimum settlement rates were compared with earlier projections. They were generally somewhat faster than results from previous laboratory saline creep testing combined with theoretical pile design based on creep settlement. The tests highlight the dramatic reductions in foundation bearing capacity and acceleration in pile creep rates that can be expected in permafrost exhibiting significant pore water salinity. A simplified testing procedure suitable for laboratory or field testing is described. (Author's abstract)
W88-07425

STAINLESS STEEL GAINS GROUND ON CORROSION,
Clamp-All Corporation, Haverhill, Massachusetts.
J. Tarara.
Water Engineering and Management WENMD2, Vol. 135, No. 1, p 33-34, January, 1988. 2 tab.

Descriptors: *Steel, *Corrosion control, *Metal pipes, *Alloys, *Stainless steel, Pipes, Pipelines, Iron, Heavy metals, Chromium, Corrosion, Soil types, Soil properties, Maintenance.

The use of stainless steel to shield metal pipes from corrosion is reviewed. Superalloys containing such elements as nickel, molybdenum, and titanium in addition to the basic iron and chromium exhibit tremendous strength along with greatly increased corrosion resistance. The 300 series demonstrates these qualities the best, and most stainless steel pipe, couplings, and fittings are made from Type 301 and Type 304. Tests by the National Bureau of Standards show that Type 304, containing 18% Cr and 8% Ni, is superior to Type 301, especially for underground, in-soil applications. Great strength, along with high resistance to shearage and deflection, make stainless steel an extremely effective pipe coupling material, increasing the life of plumbing and other piping systems. As research continues to improve the quality of stainless steels, and their use spreads within industry, costs should come down even as their corrosion resistance and tensile strength increase. (Doria-PTT)
W88-07648

FIELD INVESTIGATION OF A NEOPRENE PAD CAPPING SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
B. D. Neeley, and R. J. Becker.
Available from the National Technical Information Service, Springfield, VA. 22161, as ADA190496. Price codes: A03 in paper copy; A01 in microfiche. Miscellaneous Paper No. SL-88-3, February 1988. Final Report. 39 p, 3 fig, 8 tab, append.

Descriptors: *Neoprene, *Capping, *Field tests, *Testing procedures, *Concrete testing, *Materials testing, Sulfur mortar, Mortar, Gypsum, Cements.

Cylindrical concrete specimens to be tested for compressive strength are prepared according to CRD-C 29 (ASTM C 617), Standard Practice for Capping Cylindrical Concrete Specimens, and tested according to CRD-C 14 (ASTM C 39), Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. Previous work indicated that: (1) High circumferential stresses are likely to develop in rings placed around the ends of test specimens to confine gypsum-plaster-capping compound; (2) Low-strength capping material (<300 psi) should be used only for capping low-strength concrete specimens and then only if high-strength material is not available; and (3) Lubricant on the cap of a compressive test specimen has no effect on the compressive strength if the thickness is very slight as would result from wiping with a greasy cloth. Recently, reusable neoprene pads inserted into steel retainer caps have been introduced as a possible alternative to the capping materials referred to in CRD-C 29, neat cement mortar, high strength gypsum plaster, and sulfur mortar. Several state highway departments have used the neoprene pad capping system (NPCS) with at least two states adopting its use. A field investigation was conducted of a neoprene pad capping system (NPCS) that is marketed as an alternative to the capping materials referred to in CRD-C 29 (ASTM C 617). The results indicate that within the range of 500 to 5,500 psi, the NPCS appears to be an acceptable alternative to sulfur-mortar caps for testing the compressive strength of 6-in.-diameter by 12-in-high cylindrical concrete specimens. The

NPCS also eliminates a potential safety hazard resulting from working with the sulfur mortar and could constitute a substantial cost savings. (Lantz-PTT)
W88-07762

DEMONSTRATION OF THE CONSTRUCTIBILITY OF A PRECAST CONCRETE STAY-IN-PLACE FORMING SYSTEM FOR LOCK WALL REHABILITATION,
ABAM Engineers, Inc., 33301 Ninth Ave. South, Federal-Way, Washington.
For primary bibliographic entry see Field 8F.
W88-07983

8I. Fisheries Engineering

FISH AND MACROCRUSTACEAN USE OF SUBMERGED PLANT BEDS IN TIDAL FRESHWATER MARSH CREEKS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W88-06854

REGULATED FLUSHING IN A GRAVEL-BED RIVER FOR CHANNEL HABITAT MAINTENANCE: A TRINITY RIVER FISHERIES,
Battelle Memorial Inst., Denver, CO. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5G.
W88-06965

ZOOPLANKTON ABUNDANCE IN UNSTOCKED MARICULTURE PONDS AT THREE SALINITIES,
Texas Park and Wildlife Department, The Perry R. Bass Marine Fisheries Research Station, Star Route, Box 385, Palacios, Texas 77465.
R. L. Colura, G. C. Matlock, and A. F. Maciorowski.
Progressive Fish Culturist PFCUAY, Vol. 49, No. 4, p 253-259, October 1987. 4 fig, 3 tab, 25 ref.

Descriptors: *Zooplankton, *Saline water, *Fish ponds, *Fish farming, *Saline ponds, *Aquaculture, Fish food, Ponds, Salinity, Texas, Foods, Population density, Populations, Rotifers, Polychaetes, Copepods.

Zooplankton abundance in unstocked saltwater fish culture ponds was studied over 4 weeks in southern Texas. Paired 0.2-hectare ponds were filled with bay and well water to yield salinities of 10, 15, and 20% and were fertilized with 568 kilograms of cottonseed meal per hectare. Dominant zooplankton groups were compared to determine which salinity produced the best forage base for culture of euryhaline marine fish. Peak total zooplankton densities occurred at day 9 in 10% salinity ponds, and day 23 in the 15 and 20% salinity ponds. Further, peak total zooplankton densities were approximately five times greater in the 10% salinity ponds than in the 15 and 20% salinity ponds. Acartia tonsa densities were unaffected by the salinities tested. Oithona sp. densities were significantly greater at 15%. Densities of mixed rotifers, copepod nauplii, and polychaete larvae were significantly greater at 10%. Accordingly, pond salinities of 10% appeared to provide the best zooplankton forage base for culture of euryhaline fish. (Author's abstract)
W88-07075

ACUTE TOXICITY OF AMMONIA AND NITRITE TO SPOTTED SEATROUT,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 5C.
W88-07076

PREEXPOSURE AND SUBSEQUENT RESISTANCE TO LEAD IN YEARLING BROOK TROUT, SALVELINUS FONTINALIS,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-07091

CULTURE OF MARINE MICROALGAE WITH NATURAL BIODIGESTED RESOURCES,
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico). Div. of Oceanology.
For primary bibliographic entry see Field 5E.
W88-07116

ESTIMATING MICROBIAL PRODUCTION AND GROWTH RATES IN AQUACULTURE PONDS USING RATES OF RNA AND DNA SYNTHESIS,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W88-07118

OCCURRENCE AND DIET OF FISHES IN A TIDAL INLET TO A SALTMARSH IN SOUTHERN MORETON BAY, QUEENSLAND,
Fisheries Management Branch, Department of Primary Industries, Brisbane, Qld 4000, Australia.
R. M. Morton, B. R. Pollock, and J. P. Beumer.
Australian Journal of Ecology AJECDQ, Vol. 12, No. 3, p 217-237, September 1987. 11 fig, 4 tab, 35 ref.

Descriptors: *Estuarine environment, *Inlets, *Saltmarshes, *Fish, *Fish diets, *Fish populations, *Australia, Tidal rivers, Tidal marshes, Estuarine fisheries, Marine animals, Fish food organisms, Fish behavior.

The fishes occurring in the main tidal inlet to a typical saltmarsh situated in southern Moreton Bay were studied from January to December 1984 to determine the type of fishes and their feeding habits within the inlet, particularly for species of economic importance. Sampling was conducted at night on the full and new moon phases, and during the day on the full moon phase. A total of 19 species were recorded from the inlet, of which 11 are of economic importance. Six species were considered common. Most fish which entered the inlet were juveniles. The diversity of the fish assemblage from the inlet was low when compared with findings of other studies conducted in Australian subtidal mangrove areas. Diel differences in the size of fish entering the inlet were recorded for several species. Two mark-recapture programs were conducted to investigate short-term utilization of the saltmarsh by fishes. Recapture rates indicated that individuals of some species regularly utilized the saltmarsh. The most abundant species from the inlet were predominantly benthic feeders although one species fed on plankton. Terrestrial foods formed an important part of the diet of some fishes. The inlet serves as a feeding area for certain species though it is unlikely that these species rely exclusively upon the area. Future management of saltmarsh areas should include protection and maintenance of tidal inlets wherever possible. (Author's abstract)
W88-07167

ACIDIFICATION AND ANADROMOUS FISH OF ATLANTIC ESTUARIES,
Brookhaven National Lab., Upton, NY. Terrestrial and Aquatic Ecology Div.
For primary bibliographic entry see Field 5C.
W88-07255

SUMMARY OF THE IMPACT OF ACID RAIN ON ATLANTIC SALMON (SALMO SALAR) IN CANADA,
Fisheries Research Branch, Halifax, Nova Scotia B3J 2S7, Canada.
For primary bibliographic entry see Field 5C.
W88-07258

ATLANTIC SALMON RESOURCES IN THE NORTHEASTERN UNITED STATES AND THE POTENTIAL EFFECTS OF ACIDIFICATION FROM ATMOSPHERIC DEPOSITION,
Maine Univ., Orono. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-07259

STATUS OF SOME FINFISH STOCKS IN THE CHESAPEAKE BAY,
Maryland Dept. of Natural Resources, Annapolis. Fisheries Administration.
For primary bibliographic entry see Field 5C.
W88-07260

ACIDIFICATION EFFECTS ON LARVAL STRIPED BASS, MORONE SAXATILIS IN CHESAPEAKE BAY TRIBUTARIES: A REVIEW,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W88-07262

INFLUENCE OF PH ON THE TOXICITY OF ALUMINIUM AND OTHER INORGANIC CONTAMINANTS TO EAST COAST STRIPED BASS,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W88-07263

RESIDUES OF ORGANOCHLORINE PESTICIDES IN FISH FROM THE ARABIAN GULF,
Department of Environmental Marine Chemistry, Marine Science Centre, The University, Basrah, Iraq.
For primary bibliographic entry see Field 5B.
W88-07270

COMPARISON OF GRANULAR AND LIQUID INORGANIC FERTILIZERS USED IN STRIPED BASS AND SMALLMOUTH BASS REARING PONDS,
Texas Parks and Wildlife Department, Fort Worth Research Unit, 6200 Hatchery Road, Fort Worth, Texas 76114, USA.
B. W. Farquhar.
The Progressive Fish-Culturist PFCUAY, Vol. 49, No. 1, p 21-28, January, 1987. 3 fig, 3 tab, 12 ref. Texas Parks and Wildlife Dept. Project No. F- 31-R.

Descriptors: *Bass, *Fish farming, *Ponds, *Fertilizers, *Fish hatcheries, *Inorganic compounds, Performance evaluation, Aquaculture, Farming, Fisheries, Water quality, Zooplankton, Plankton, Density, Population density, Ammonium, Phosphorus, Phosphorus compounds, Survival, Growth, Cost analysis, Growth stages, Juvenile growth stage.

A study was conducted in eight striped bass (Morone saxatilis) and eight smallmouth bass (Micropterus dolomieui) rearing ponds to compare the effects of two fertilization regimes on water quality, zooplankton densities, and fish production. One treatment utilized granular inorganic fertilizer (diammonium phosphate), and the other utilized liquid inorganic fertilizer (phosphoric acid and ammonium nitrate). Both treatments were supplemented with cottonseed meal. No differences were found in water quality, zooplankton densities, or fish yields. Both treatments produced adequate zooplankton for survival and growth of fingerlings in rearing ponds at stocking rates of 494,000 fry/hectare for striped bass and 19,000-81,000 fry/hectare for smallmouth bass. Liquid fertilization was the more expensive, costing approximately 200% more than granular fertilizer, and required specialized equipment to safely transport, store, and apply the highly caustic liquids. (Author's abstract)
W88-07660

USE OF WATER CONDITIONERS IN WATER-RECIRCULATION SYSTEMS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 3C.
W88-07661

SUSPENDED SPAWNING CANS FOR CHANNEL CATFISH IN A SURFACE-MINE LAKE,
Fisheries Research Laboratory, Southern Illinois University, Carbondale, Illinois 62901, USA.
P. B. Moy, and R. R. Stickney.
The Progressive Fish-Culturist PFCUAY, Vol. 49, No. 1, p 76-77, January, 1987. 1 fig, 3 ref.

Descriptors: *Spawning, *Catfish, *Catfish ponds, *Strip mine lakes, Lakes, Ponds, Predation, Foods, Fish food.

A technique is described for enabling channel catfish (Ictalurus punctatus) to spawn in lakes where insufficient spawning habitat is available. The study site was a 1.5-hectare surface-mine lake near Carbondale, IL. Nine 45-liter spawning cans were suspended from styrofoam floats at a depth of 1.25 m below the water surface, in water that was 2 to 5 m deep. Cans were lifted to the surface and examined every 7 to 10 days. Initial spawning activity occurred in mid-June, and fish continued to utilize the containers through the last week of July when water temperature at nest depth was 29.5 C. Both eggs and fry were observed in the containers. Eggs were also recovered in four cans recovered from the lake bottom after having broken free of the floats during severe winds. It is concluded that channel catfish can spawn at depths up to 5 m if satisfactory nesting sites are available. The receptacles need not be in contact with the substrate, nor must they face the center of the lake. (Doria-PTT)
W88-07662

EVALUATION OF GAS SUPERSATURATION TREATMENT EQUIPMENT AT FISH HATCHERIES IN MICHIGAN AND WISCONSIN,
U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, LaCrosse, WI 54602, USA.
For primary bibliographic entry see Field 5F.
W88-07663

EFFICACY OF ULTRAVIOLET WATER TREATMENT AT THE GREEN LAKE, MAINE, NATIONAL FISH HATCHERY,
Leadville National Fish Hatchery, 2842 County Road 300, Leadville, CO 81638, USA.
For primary bibliographic entry see Field 5F.
W88-07664

MORPHOLOGIC LESIONS AND ACUTE TOXICITY IN RAINBOW TROUT (SALMO GAIRDNERI) TREATED WITH 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Department of Veterinary Pathology, Cornell University, Ithaca, New York.
For primary bibliographic entry see Field 5C.
W88-07706

2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN TOXICITY IN YELLOW PERCH (PERCA FLAVESCENS),
Department of Veterinary Pathology, Cornell University, Ithaca, New York.
For primary bibliographic entry see Field 5C.
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LETHAL TOXICITY OF LINDANE ON A TELEOST FISH, ANGUILLA ANGUILLA FROM ALBUFERA LAKE (SPAIN): HARDNESS AND TEMPERATURE EFFECTS,
Valencia Univ. (Spain). Dept. of Animal Physiology.
For primary bibliographic entry see Field 5C.
W88-07712

MONITORING OF DOWNSTREAM SALMON AND STEELHEAD AT FEDERAL HYDROELECTRIC FACILITIES - 1986,
National Marine Fisheries Service, Portland, OR. Northwest Region.
For primary bibliographic entry see Field 2H.
W88-07745

NATURAL PROPAGATION AND HABITAT IMPROVEMENT, VOLUME II - IDAHO: ANNUAL AND FINAL REPORTS, 1985.
Bonneville Power Administration, Div. of Fish and Wildlife.
For primary bibliographic entry see Field 2H.
W88-07763

WALDE, DEADMAN, LOWER FISH, AND BOULDER CREEKS ANADROMOUS FISH HABITAT SURVEY AND ENHANCEMENT PLAN,
Clearwater National Forest. Lochsa District.
For primary bibliographic entry see Field 2H.
W88-07764

LOCHSA RIVER TRIBUTARIES ENHANCEMENT PROPOSAL,
Clearwater National Forest.
For primary bibliographic entry see Field 2H.
W88-07765

ELDORADO CREEK FISH PASSAGE,
Clearwater National Forest.
W. Murphy, and A. Espinosa.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. Final Report, December 2, 1985. p 92-136, 27 fig, 10 append. DOE Contract No. DE-A179-54BP16535, Project No. 84-6.

Descriptors: *Fish passages, *Eldorado Creek, *Idaho, Costs, Fish migration, Fish conservation, Fish barriers.

The 1984 Eldorado Creek Fish Passage Annual Report, detailed project origination, objectives description of the project area, methods and materials used in 1984 and the results, conclusions and recommendations. Generally, these recommendations called for improving length, width, and depth of the pools created in 1984, and were the basis for extending the project into 1985. In 1985, an additional $13,000 was allocated for the Eldorado Creek Barrier Removal Project. The action brought the total project funding to $30,668. The 1985 methodologies, results and conclusions are described. Corrective actions taken in 1985 have eliminated high and low flow upstream migration barriers for anadromous fish at all 4 sites in Eldorado Creek. The results obtained in 1985 were completely satisfactory, and no further work is necessary. (See also W88-07763) (Lantz-PTT)
W88-07766

ELDORADO CREEK: A PLAN FOR ENHANCEMENT OF KEY ANADROMOUS FISH HABITAT IN THE CLEARWATER RIVER BASIN,
Clearwater National Forest, Pierce Ranger District.
A. Espinosa, R. Vogelsang, and W. Murphy.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. p 137-193, 13 fig, 15 tab, 9 append. DOE Contract No. DE-AI79-85BP16535, Project No. 84-6.

Descriptors: *Eldorado Creek, *Anadromous fish, *Fish management, *Fisheries, Fish conservation, Salmon, Trout, Fish ponds, Costs, Fish hatcheries, Stream fisheries, Cost benefit analysis.

The objective of the proposed Eldorado Creek Habitat Improvement Project is to improve the productive capability of 12 miles in Eldorado Creek and 5.1 miles in six selected tributaries. A total of 54 to 64 acres of summer and winter rearing habitat would be enhanced over a 4 year period. In addition, 2.5 acres of anadromous spawning habitat would be improved for spring chinook salmon and steelhead trout. Current conditions throughout the Eldorado Creek rearing system indicate that pool frequency, pool quality, bank stability, and cobble embeddedness are areas where enhancement efforts should be concentrated. In-stream structures designed to ameloriate these factors were chosen as the treatment of choice for the Eldorado Drainage. Reintroduction of streamside cover was also indicated. A total of 346 structures, 1.5 miles of riparian zone, and 100 pools would be constructed or planted under this proposal at a total cost of $93,775. Average annual cost is $21,700. Average cost per structure is $175. The benefit cost ratio for the proposal is 27.1 to 1. (See also W88-07763) (Lantz-PTT)
W88-07767

UPPER CROOKED FORK FISH BARRIER REMOVAL,
Clearwater National Forest.
R. P. Kramer, E. M. Oman, and F. A. Espinosa.
IN: Natural Propagation and Habitat Improvement, Volume II - Idaho: Annual and Final Reports, 1985. p 194-259, 54 fig, 2 ref, 3 append. DOE Contract No. DE-AI79-85BP16535, Project No. 84-6.

Descriptors: *Upper Crooked Fork Creek, *Fish management, *Fish barriers, *Idaho, Fisheries, Salmon, Anadromous fish, Fish migration, Stream fisheries, Hopeful Creek, Fish passages, Spawning, Fish hatcheries.

Crooked Fork Creek is one of the principal tributaries of the Lochsa River. It contains the bulk of the remaining high quality spawning and rearing habitats for anadromous fish on the Clearwater National Forest. It is estimated that 25% of the total chinook Salmon and 25% of the total steelhead smolt production of the Clearwater National Forest emanate from this drainage. The long-term ability to restore anadromous fish runs to the upper Lochsa system is dependent upon increasing the available spawning habitat in the Crooked Fork drainage. Stream and habitat surveys performed in 1983 on the Crooked Fork established that several natural waterfalls and rock chutes totally preclude upstream migration of spring chinook salmon during late summer flows. At some high flows summer steelhead are able to negotiate the barriers. Seven major barriers and five partial barriers were drilled and blasted in the summer of 1984. Following evaluation in 1985, six of the major barriers and four of the partial barriers required additional work. Deep take-off pools, resting areas, and gentler gradients were created to increase fish passage. An additional barrier was identified on Hopeful Creek, a tributary of the Crooked Fork, and was removed. (See also W88-07763) (Author's abstract)
W88-07768

SOUTH FORK CLEARWATER RIVER HABITAT ENHANCEMENT: ANNUAL REPORT - 1985,
Nezperce National Forest.
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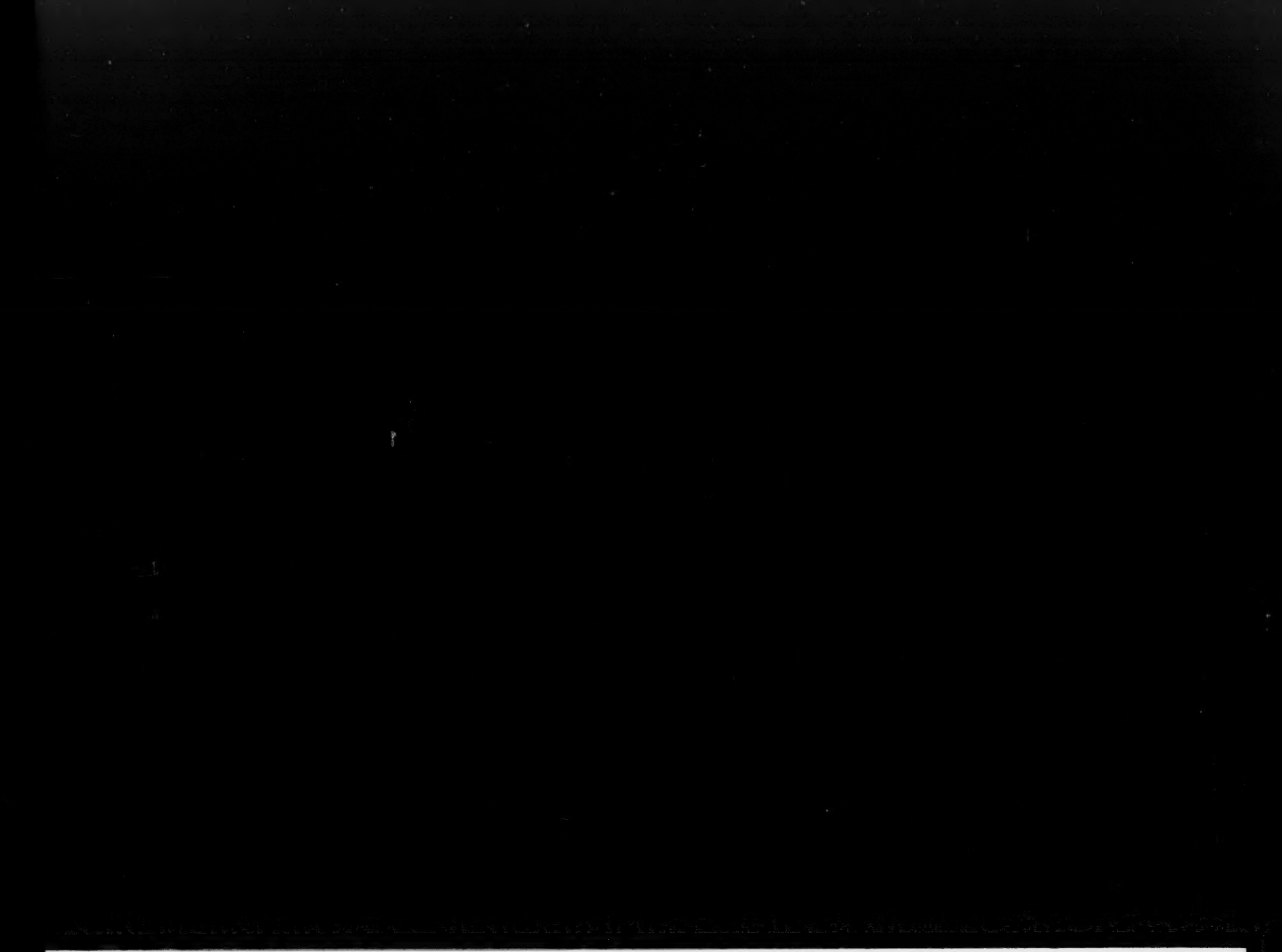
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